AD NUMBER
AD909720
LIMITATION CHANGES
TO: **Approved for public release; distribution is unlimited.**
FROM: **Distribution authorized to U.S. Gov't. agencies only; Test and Evaluation; APR 1973. Other requests shall be referred to Naval Weapons Laboratory, Dahlgren, VA 22448.**
AUTHORITY
USNWL ltr, 10 Aug 1973

Best

Available

Copy

7

NWL TECHNICAL REPORT TR-2895
April 1973

AN ANALYSIS OF AIR BLAST PRESSURE DATA ON THE SURFACE OF A SPARTAN MISSILE ASSEMBLY

L. P. Anderson, Jr.

U.S. NAVAL WEAPONS LABORATORY
DAHLGREN, VIRGINIA

NWL

NAVAL WEAPONS LABORATORY
Dahlgren, Virginia
22448

R. F. Schniedwind, Capt., USN
Commander

Bernard Smith
Technical Director

NWL TECHNICAL REPORT TR-2895
April 1973

AN ANALYSIS OF AIR BLAST PRESSURE DATA ON THE SURFACE OF A SPARTAN MISSILE ASSEMBLY

by

L. P. Anderson, Jr.

Test and Evaluation Department

ABSTRACT

This report describes an unsteady pressure distribution due to a blast wave diffracting around a SPARTAN missile assembly. The pressure data were obtained from a series of five tests performed in the DASACON Conical Shock Tube Facility located at the Naval Weapons Laboratory, Dahlgren, Virginia. These tests were conducted during the period 17 April 1972 to 8 May 1972. During these tests the missile assembly was subjected to incident blast waves which had peak overpressures of from 2.9 psi to 11.8 psi and corresponding positive overpressure durations of from 380 milliseconds to 444 milliseconds.

The report describes the pressure data for each test and the empirical function used to represent these data. It then describes the method of integrating the empirical function at given times for the missile assembly sections of interest. The results of these calculations for all five tests are given at selected times. The calculation period covers approximately seven milliseconds beginning at the time the blast wave first encounters the missile assembly. These results are given as force vs time plots in Appendix D.

FOREWORD

This work was performed by the Naval Weapons Laboratory (NWL), Dahlgren, Virginia, for McDonnell-Douglas Astronautics Company (MDAC) in accordance with MDAC test control drawing number 1T4-7031, 29 March 1972. Funding was provided by the U. S. Army Safeguard Systems Commander under MIPR No. A31699-23-V180, PRON No. OR-23-V180, and CMC Code 527A.000.

This report was reviewed by J. J. Yagla and F. F. Churchill of the Test and Evaluation Department.

Released by:

L. A. Clayberg

L. A. CLAYBERG, Head
Test and Evaluation Department

CONTENTS

CONTENTS (Continued)

APPENDICES:

I. INTRODUCTION

The analysis described in this report was performed for McDonnell-Douglas Astronautics Company in connection with a series of five air blast loading tests on a SPARTAN missile assembly. This assembly, shown in Figure 1, consisted of a nose fairing, the control section, the guidance section, and a dummy warhead. The shaded sections are the ones on which force calculations were performed.

The missile assembly was tested in the 22 foot diameter test area (test area 3) of the conical shock tube (DASACON) at the Naval Weapons Laboratory (see Figure 2). These tests are designated by DASACON test numbers 114-118, and are described in reference (a)[1]. As shown in Figure 3, the missile assembly was suspended from the top of the test area in a nose down position. The peak overpressures and the positive durations of the incident blast waves, along with the ambient temperature and pressure, are listed for each test in Table 1.

The objectives of these tests were to measure accelerations on portions of the assembly's primary structure, and overpressures on the assembly's surface. This report is concerned with the surface pressure distribution. The pressure data were fitted to the equation,

$$p(s,\theta) = \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} s^{i-1} \cos\left[(j-1)\theta\right] \qquad (1)$$

where:

p is pressure,

s is logitudinal distance along the surface measured from the assembly tip,

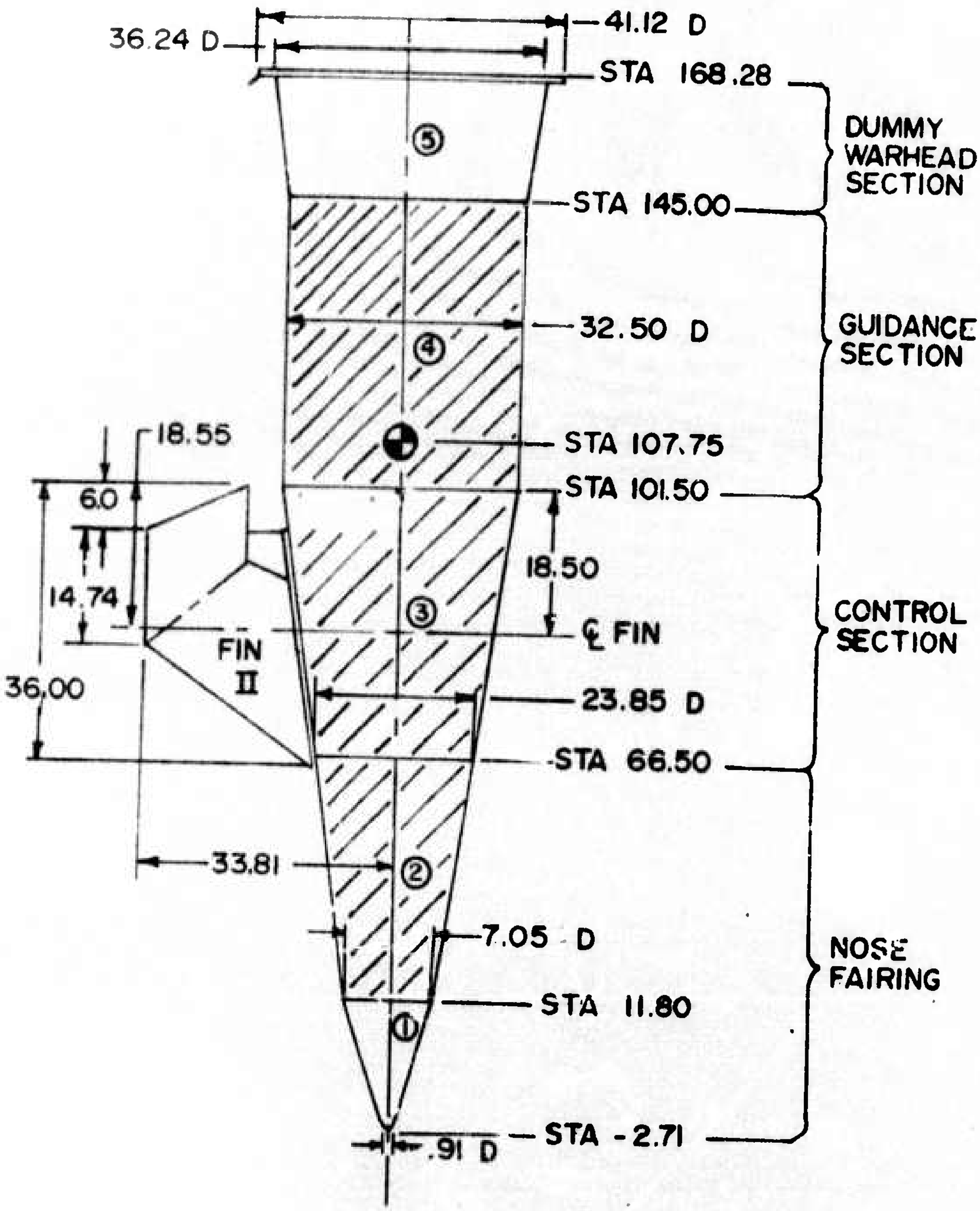
θ is circumferential angle measured from the forward stagnation line on assembly surface,

b_{ij} are coefficients determined by fitting the equation to the experimental data.

The data fitting was performed at given times for a period of approximately seven milliseconds. By means of equation (1), the pressure can be determined at any point on the surface of the major sections of the missile assembly for the given times.

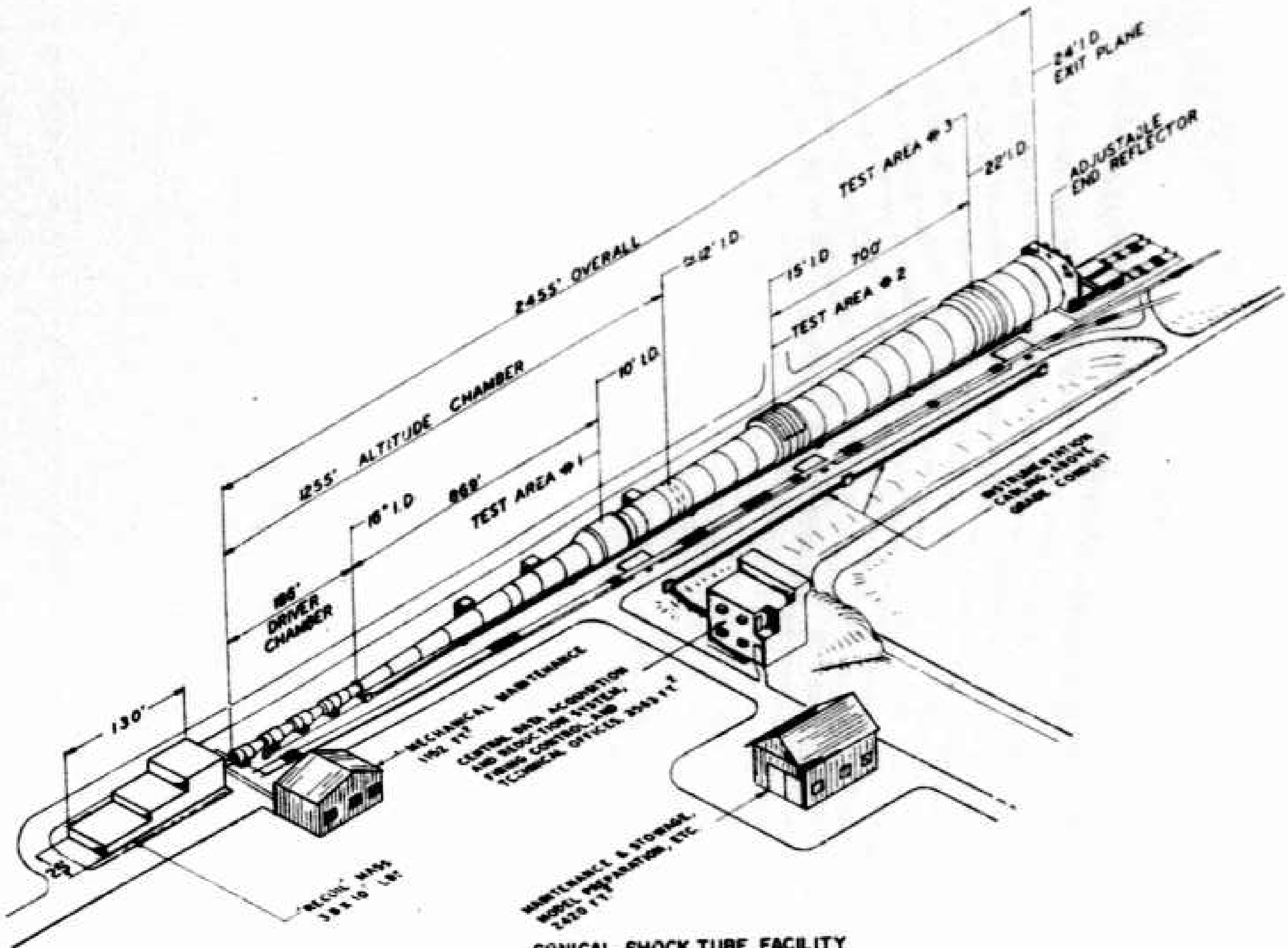
---

[1]The references are located on page 38.



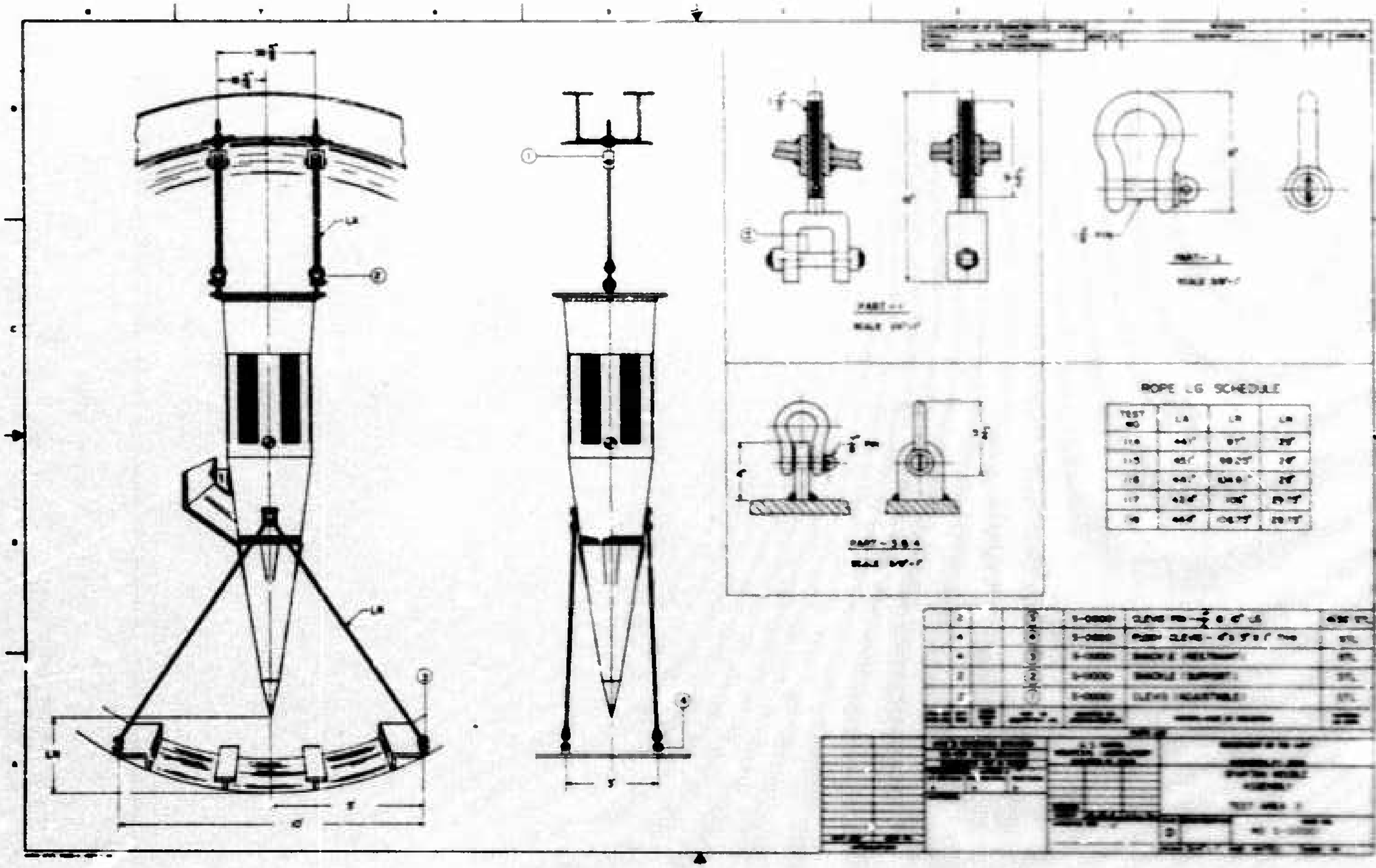
SPARTAN MISSILE ASSEMBLY

FIGURE 1



CONICAL SHOCK TUBE FACILITY
U S NAVAL WEAPONS LABORATORY
DAHLGREN, VIRGINIA

FIGURE 2



SUSPENDED MISSILE ASSEMBLY

FIGURE 3

TABLE 1

SUMMARY OF TEST CONDITIONS

Test No.	Peak Overpressure (psig)	Positive Duration (ms)	Ambient Temperature (°F)	Ambient Pressure (psia)
114	4.2	380	76	14.85
115	11.8	440	67	14.81
116	11.7	444	71	14.84
117	4.9	383	62	14.61
118	2.9	380	71	14.71

Such an expression is especially useful in calculating pressure forces on the assembly sections. A particular application for the DASACON tests was to integrate the pressure over the three major sections of the missile assembly. These integrations will be called "forces" throughout this report although it is not quite proper to do so.[2] Thus, the word "force", without any qualification, is to be taken as the integral of the pressure. Force vs time data was used by MDAC as a characteristic of the structural loading of the missile assembly produced by the DASACON environment. These data were compared with similar data produced by other environments.

The objectives of this report are to describe the pressure data taken during the DASACON tests and to show how these data were used to obtain the force calculations. The pressure data are described in Section II and the method of fitting the data to equation (1) is discussed in Section III. The integration of equation (1) is discussed in Section IV, where the following assumptions are made:

a. The pressure distribution is symmetrical, i.e., the effects of the fin located on the control section (See Figure 1) are ignored.

b. The shock wave is plane as it diffracts around a given section.

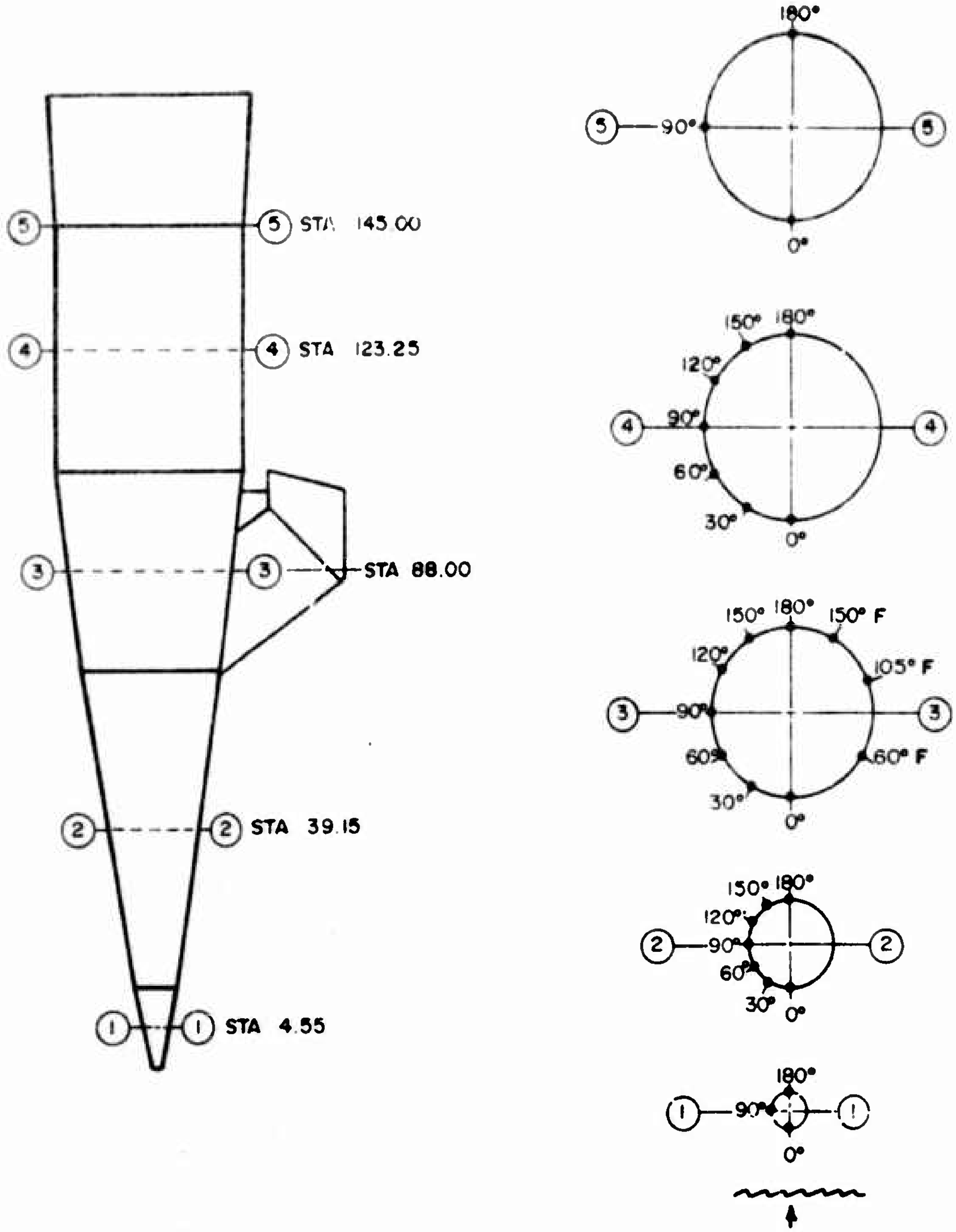
Section V discusses the results of the force calculations and estimates the maximum effects of including measurements on the fin side in the analysis. Tables of the b_{ij} coefficients in equation (1) are given in Appendix C for each calculation time of each test. Comparisons of the results of the pressure fits and experimental data are given in Appendix D. Section VI gives conclusions and recommendations.

II. DESCRIPTION OF PRESSURE DISTRIBUTION

Figures 4 and 5 show the locations of the pressure transducers on the missile assembly surface during the DASACON tests. The differences between these figures are due to a 180° rotation of the assembly about its axis after the second test of the

---

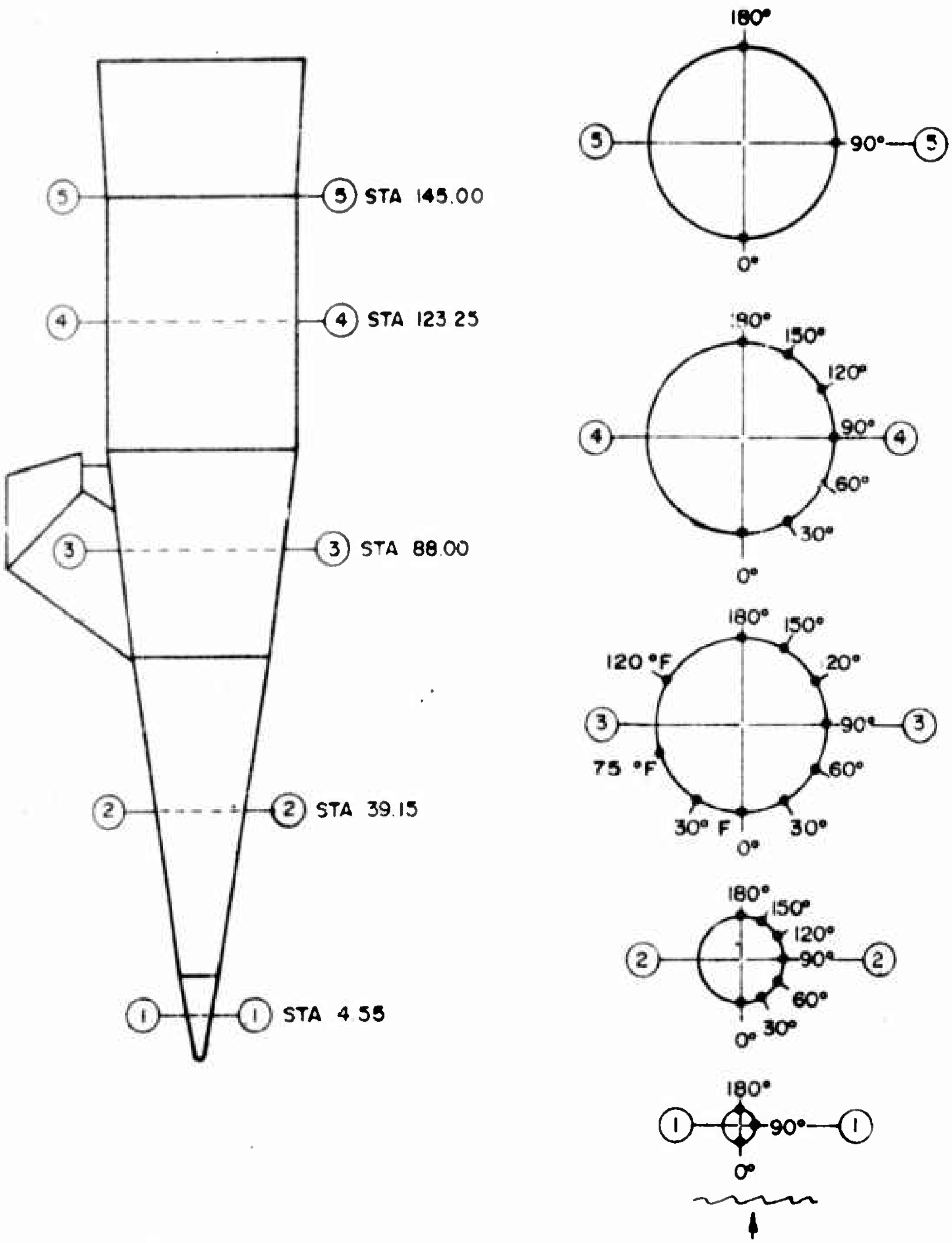
[2]The integral of the pressure over the assembly surface has the dimensions of a force, but does not specify any direction. Thus it cannot be properly regarded as a vector quantity such as force.



PRESSURE TRANSDUCER LOCATIONS ON SURFACE OF SPARTAN MISSILE ASSEMBLY

TESTS 114-115

FIGURE 4



PRESSURE TRANSDUCER LOCATIONS ON SURFACE OF SPARTAN MISSILE ASSEMBLY

TESTS 116-117-118

FIGURE 5

series (test No. 115). The number of pressure transducers on the surface of the assembly was limited to 30. Therefore, in order to define the pressure distribution more accurately, most of these gauges were placed on one side of the assembly. Transducers were placed on the side opposite the fin at intervals of 30° around the circumferences of the sections of interest (see Figure 1). Three transducers were placed at stations 1 and , so that data from the boundaries of the integration region could be obtained. Three transducers, designated by the letter F were placed at station 3 (control section) on the fin side to determine the maximum effects of the fin.

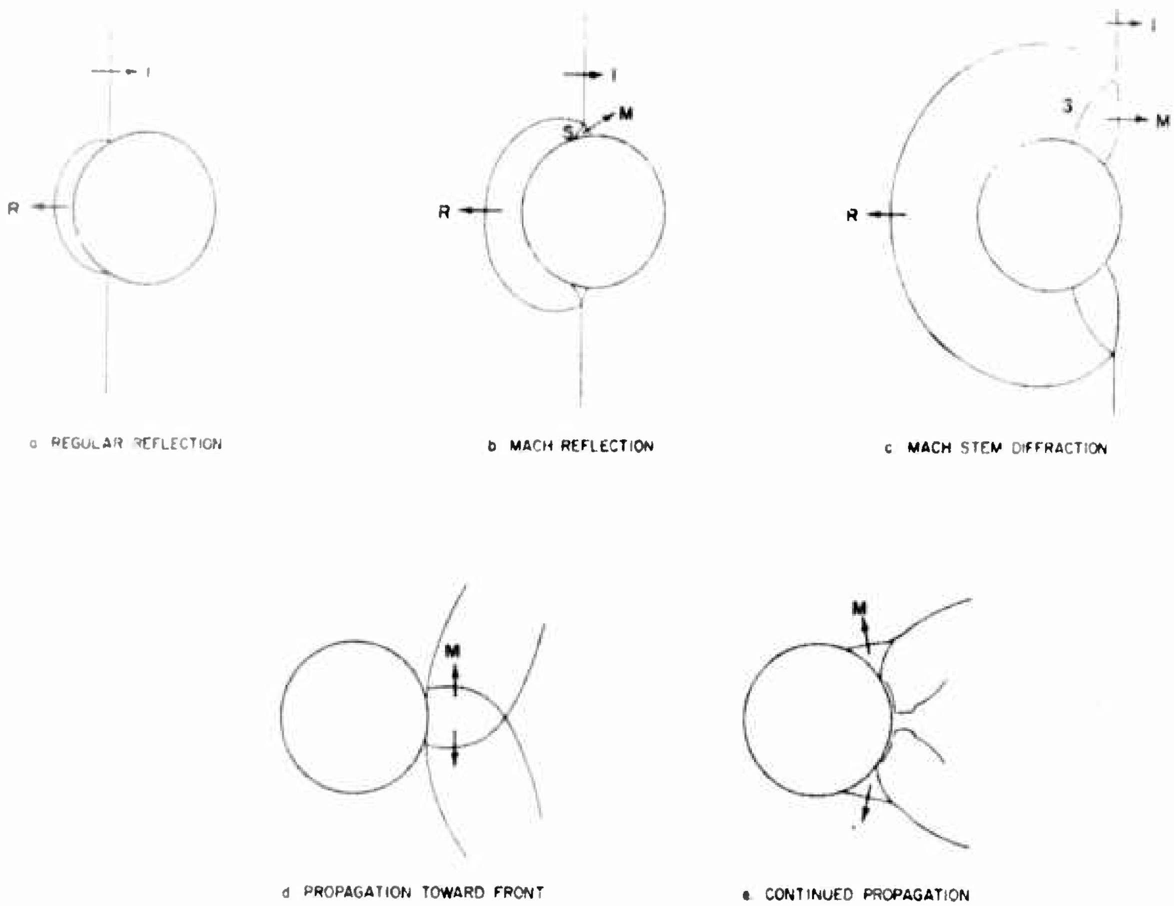
The data from these measurements were recorded on magnetic tape (reference (a)). In order to have smooth data for the calculations, the tapes were played back through low pass, linear phase analog filters with a cutoff frequency of 8 KHz. The data were then digitized, and plotted by a CALCOMP plotter. The resulting plots were carefully examined and then smoothed by hand. The smoothed data were digitized on punched cards at a rate of 1000 samples per second for use in a computer.

The smoothed data from each test are given in Appendix A for the finless side of the missile assembly. Unsmoothed data for the fin side are given in Appendix B. The appendices contain graphs of pressure vs time at the given circumferential angles. The station number for each curve is listed on the right side of each figure. The zero time in the figures of Appendix A is the time that the shock first touches the missile assembly. The symbol, T_0, located at the lower left of the figures in Appendix B, designates an arbitrary common time.

A. Shock Diffraction Process

Before the pressure records are discussed, a brief description of the shock diffraction process will be given. Since the cross section at each axial position of the missile assembly is circular, the shock diffraction at a given axial position is similar to the diffraction of a shock around a cylinder.

Shadowgrams of the diffraction of a shock wave around a cylinder are given in reference (b). Figure 6, which shows the diffraction at various stages of engulfment, is based on these shadowgrams. Figure 6a shows a regular reflection of the shock wave on the front of the cylinder surface. Regular reflection occurs until the angle, α, between the plane of the shock and the tangent to the surface is some critical value α_{cr} (reference (c)). This angle, α_{cr}, is dependent upon the incident shock strength. After the shock has reached the critical angle, a Mach stem is formed (Figure 6b).



I– INCIDENT SHOCK
R– INITIAL REFLECTED SHOCK
M– MACH STEM FORMED BY DIFFRACTION OF INITIAL SHOCK
S– SLIP STREAM

SHOCK WAVE DIFFRACTION AROUND A CYLINDER

FIGURE 6

This Mach stem weakens as it diffracts around the rear of the cylinder (Figure 6c). Mach stems for each side of the cylinder intersect and cross each other at $\theta = 180°$. After crossing each other, they propagate back toward the front of the cylinder (Figure 6d). As the shocks continue to propagate toward the front of the cylinder, the flow behind them is characterized by separation and vortex formation. The separation is due to the adverse pressure gradient, caused by the shocks, on the boundary layer flow (Figure 6e).

B. Measurements on Finless Side

Figures A-8 thru A-10 of Appendix A are typical of records from the front of the missile assembly, where regular reflection and initial formation of the Mach stem takes place. These records show an instantaneous rise to a peak followed by a rapid decay and then by a much more gradual decay. Figures A-11 through A-14 are typical of records from the rear of the assembly. The curves of Figures A-11 thru A-13 show an instantaneous rise to a peak followed by a decay to a minimum value and then a second rise. The time between the pressure rises decreases as the circumferential angle increases. The second pressure rise is caused by the shock from the other side of the cylinder being propagated toward the front. Figure A-14 shows the pressure records from the $\theta = 180°$ locations. These curves show peaks which have values higher than those of the $90° \leq \theta \leq 150°$ locations. The higher pressures are caused by the shock on one side of the cylinder intersecting the shock from the other side.

The curves of Appendix A for a given θ location show that the pressure variation with the longitudinal distance on the frustrum sections (sections, one, two, and three shown in Figure 1) is quite pronounced on the rear of the missile assembly. These variations are largely caused by the fact that the shock reaches the smaller diameter sections at later times then the larger ones and by the shock's engulfing the smaller diameter sections in less time. Thus, the pressure maximums and minimums occur at different times for the different frustum sections.

C. Measurements on Fin Side

Tests 115 and 116 were conducted at incident peak shock overpressures of approximately 12 psi. Since the missile assembly was rotated 180° after test 115, pressure measurements at locations of 30°, 60°, 75°, 105°, 120° and 150° were obtained on the fin side of station 3 for essentially the same incident pressure. Pressure-time plots from these measurements are shown in Appendix B in order of increasing circumferential angle. Figures B-1, B-2, and B-3 show a second pressure rise caused by the shock reflection at the

fin. Figures B-4, B-5, and B-6 show a small initial pressure rise followed by a much larger rise. The small rise is caused by the diffraction of the shock over the fin; while, the second one is caused by the influence of the reflected shock on the flow. The fin can be expected to have the following influence:

1. It will cause the pressure on the fin side to be larger than that on the finless side.

2. It will locally retard the shock on the fin side. The retarding of the shock will cause the finless side to be engulfed sooner.

III. DESCRIPTION OF PRESSURE FIT

In order to integrate the pressure on the surface of the missile assembly at a given time, t, it is desirable to express the pressure as a function of coordinates of the assembly surface at any desired time. Two convenient coordinates for this purpose are shown in Figure 7. Coordinate s is the longitudinal distance as measured along the surface from the assembly tip, and θ is the circumferential angle as measured from the windward side. Once the pressure as a function of these coordinates is found, the forces on each section can be calculated from the integral,

$$F = \iint_{A(s,\theta)} p(s,\theta)\,dA, \qquad (2)$$

where:

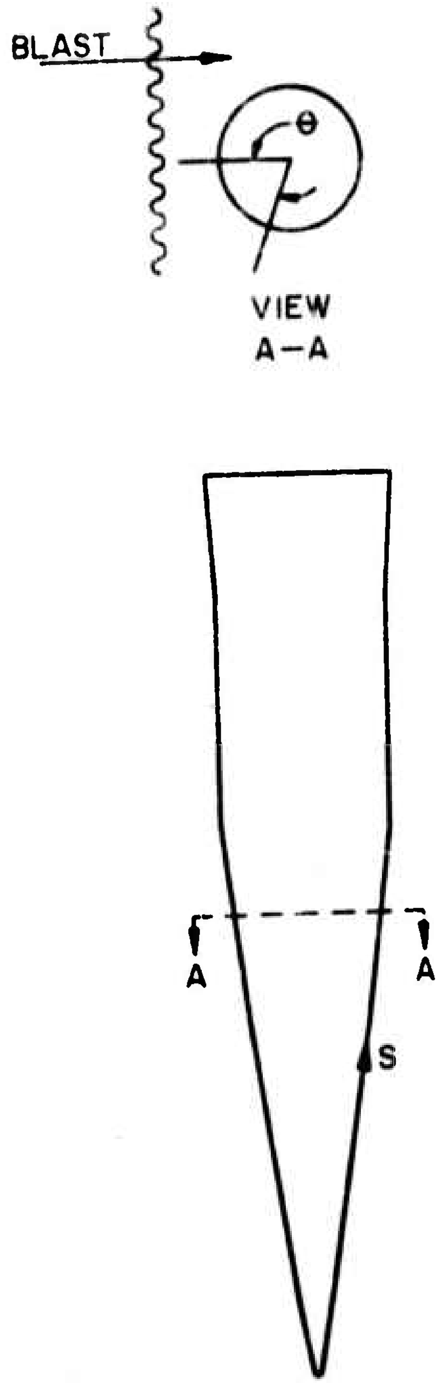
F is the force on a given section,

$A(s,\theta)$ is the sectional area engulfed by the blast wave.

The empirical function, $p(s,\theta)$, should be restricted to one which is periodic in θ with a period of 2π radians. It is also desirable that the function be easily integrable, so that numerical methods do not have to be resorted to. If symmetry is assumed, then the function must be even in θ. Thus, only one side of assembly has to be considered, i.e., $0 \le \theta \le \pi$. A cosine series in θ has these desired properties. Expressed as a cosine series, $p(s,\theta)$ has the form

$$p(s,\theta) = \sum_{j=1}^{L} B_j(s) \cos\left[(j-1)\,\theta\right], \qquad (3)$$

where $B_j(s)$ are coefficients. In order to keep $p(s,\theta)$ simple,



COORDINATES ON SURFACE OF MISSILE ASSEMBLY

FIGURE 7

$B_j(s)$ are taken as polynomials in s. Thus,

$$B_j(s) = \sum_{i=1}^{K} b_{ij} s^{i-1} . \tag{4}$$

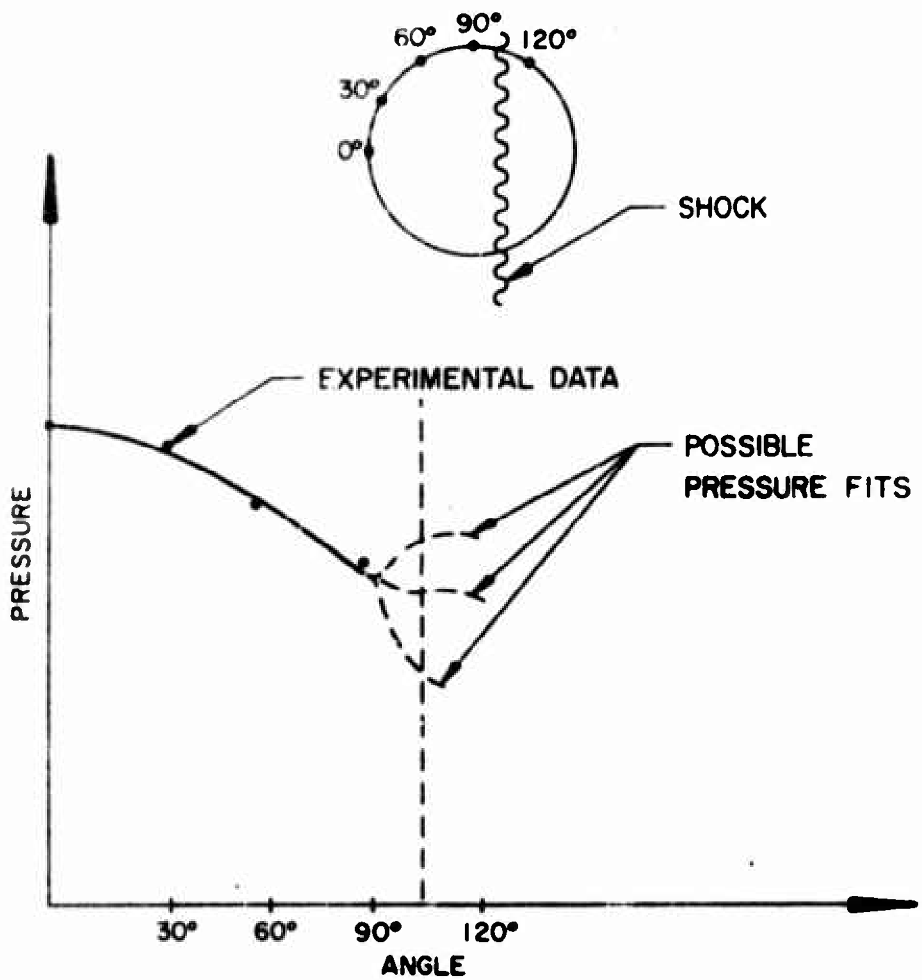
The complete function is

$$p(s,\theta) = \sum_{i=1}^{K} \sum_{j=1}^{L} b \quad s^{i-1} \cos \left[(j-1)\ \theta \right] . \tag{5}$$

Many other functions might be chosen to describe the pressure distribution. However, the one above has all of the desired properties, i.e., easily integrable, even in θ, and periodic with a period of 2π. The coefficients b_{ij} are determined by fitting the pressure data to the function at a given time, t, by the method of least squares. The summation limits, K and L, depend upon the number of data points available, i.e., the product of K and L must not exceed the number of data points available at time, t.

The total calculation time for each section is, for convenience, divided into two periods, the engulfment period, and the post-engulfment period. The engulfment period is the time required for the shock to engulf a given section. The post-engulfment period is the time after engulfment. During the engulfment period, the number of available data points varies because the number of transducers engulfed by the shock wave changes. Thus, during this phase, the limits, K and L, change from time to time. During the post-engulfment phase, the limits remain constant at K = 3 and L = 6. Of the many combinations considered, these values of K and L were found to give the best results.

The calculation times during the engulfment period must be chosen with care. The reason for this is shown with the aid of Figure 8. Consider the diffraction of the shock around a particular section of the missile assembly with the pressure transducers located every 30° from the windward side. When the shock is between two transducer locations, the function $p(s,\theta)$ may not describe the pressure accurately in the region between the transducer last engulfed and the shock front. For example, if the shock were at 117°, only four data points would be available for fitting the pressure to $p(s,\theta)$. Thus, there would be very little confidence in the function for angles greater than 90°. To avoid these inaccuracies, calculation times were chosen, during the engulfment period, as close as possible to the shock times of arrival at the various gauge locations.



EFFECT ON PRESSURE FIT WHEN SHOCK IS BETWEEN TWO TRANSDUCER LOCATIONS

FIGURE 8

IV. DESCRIPTION OF FORCE CALCULATION

With the surface pressure given at a particular time as a function of s and θ, the force on a given section can be calculated by the expression,

$$F = 2 \iint_{A/2} p(s,\theta)dA \ . \tag{6}$$

During the engulfment period, A is the area of the section that has been engulfed by the shock. During the post engulfment period, A is the total area of the section. During the engulfment period, A is bounded by the curve formed by the intersection of the shock front with the surface of the section. Of the three missile assembly sections of interest, two are conical frustrums (sections 2 and 3) and one is a cylinder (section 4). The intersection of the shock front with these two different types of sections is shown in Figure 9.

For a cylindrical section, the equation for the curve of intersection is

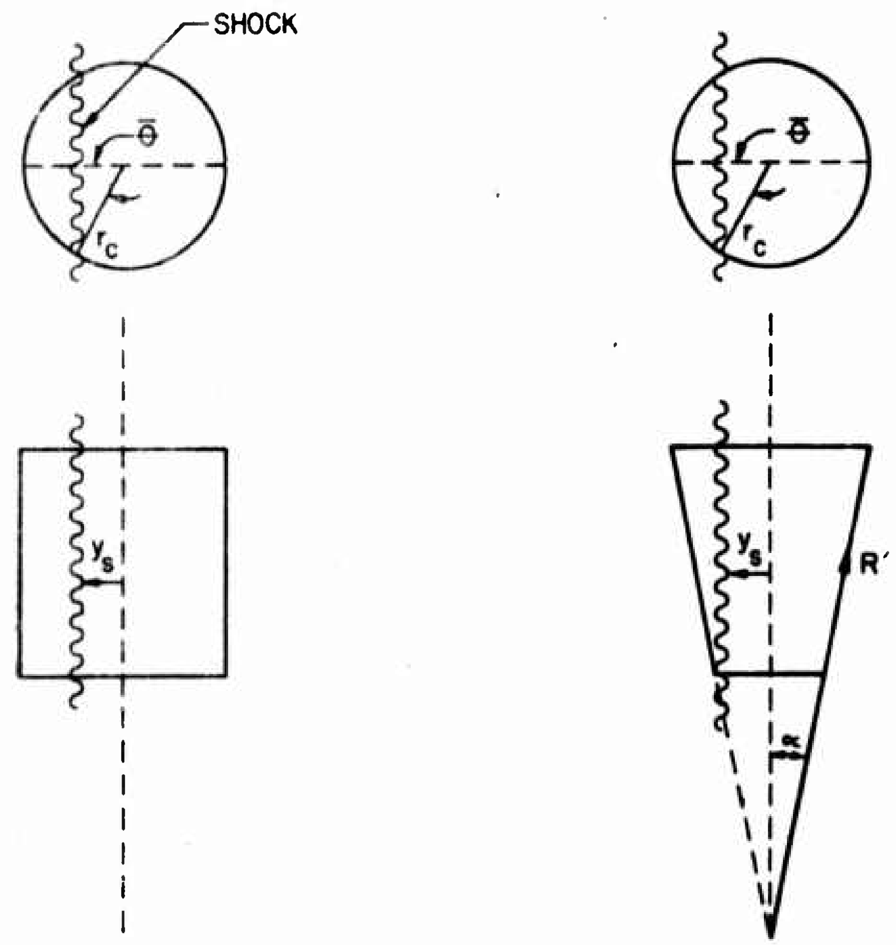
$$Y_s = r_c \cos \bar{\theta} \tag{7}$$

where, Y_s is the perpendicular distance of the shock front from the axis of the cylinder, r_c is the radius of the section and $\bar{\theta}$ is the circumferential angle at which the shock front intersects the cylinder. Y_s is positive when the shock is engulfing the front of the cylinder, but changes sign after the shock crosses the center of the cylinder. The corresponding relation for the frustrum section is

$$Y_s = \frac{\bar{R}}{\sin \alpha} \cos \bar{\theta} \tag{8}$$

where $\bar{R}$ is the length of a ray from the theoretical apex of the frustrum to a point on the boundary curve, and α is the half angle of the extended cone (see Figure 9b).

Before the force calculations are described, three different sets of functions, f_{ij}, g_{ij}, and h_{ij}, will be defined. These functions occur naturally as the results of recurring integrals, and represent the (ij) terms in double summation expressions. The first function along with the defining integral is:



a. CYLINDRICAL SECTION

b. FRUSTRUM SECTION

INTERSECTION OF SHOCK WITH MISSILE ASSEMBLY SECTIONS

FIGURE 9

$$f_{ij}(X1,X2,Y1) = \int_{X1}^{X2} \int_{0}^{Y1} X^i \cos\left[(j-1)y\right] d\,ydx \tag{9}$$

or, for $j = 1$:

$$f_{i1} = \frac{Y1}{i+1}\left(X2^{i+1} - X1^{i+1}\right) \tag{9a}$$

For $j > 1$, the general integral is

$$f_{ij} = \frac{\sin\left[(j-1)Y1\right]\left(X2^{i+1} - X1^{i+1}\right)}{(i+1)\ (j-1)}, \qquad j > 1\ , \tag{9b}$$

where $i, j = 1, 2, 3, \ldots$

The second function is:

$$g_{ij}(Y1,Y2) = \int_{Y1}^{Y2} \frac{\cos(jy)dy}{(\cos y)^i} \tag{10}$$

or:

$$g_{1,1} = Y2 - Y1\ , \tag{10a}$$

$$g_{1,2} = 2 \sin y \Big|_{Y1}^{Y2} - \frac{1}{2} \ln\left[\frac{1 + \sin y}{1 - \sin y}\right]\Big|_{Y1}^{Y2}\ , \tag{10b}$$

$$g_{1j} = \frac{2}{j-1} \sin\left[(j-1)\ y\right]\Big|_{Y1}^{Y2} - g_{1,j-2} \qquad j > 2\ , \tag{10c}$$

$$g_{2,1} = \frac{1}{2} \ln\left[\frac{1 + \sin y}{1 - \sin y}\right]\Big|_{Y1}^{Y2}\ , \tag{10d}$$

$$g_{i1} = \frac{\sin y}{(i-2)(\cos y)^{i-2}}\Big|_{Y1}^{Y2} - \frac{i-3}{i-2}\, g_{i-1,1} \qquad i > 2 \tag{10e}$$

$$g_{i2} = 2g_{i-1,1} - g_{i+1,1} \qquad i > 1 \tag{10f}$$

$$g_{ij} = 2g_{i-1,j-1} - g_{i,j-2} \qquad i > 1,\ j > 2 \tag{10g}$$

The final function is:

$$h_{ij}(Y1,Y2,X1) = \int_{Y1}^{Y2} \int_{A\sec y}^{X1} (x-d)^{i-1} \cos\left[(j-1)\, y\right] x\,dx\,dy \qquad (11)$$

or:

$$h_{i1} = \sum_{n=0}^{i-1} \frac{c_{in}}{I} \left[(Y2-Y1)\, X1^{I} - A^{I} g_{I+1,1}\right] \qquad (11a)$$

$$h_{ij} = \sum_{n=0}^{i-1} \frac{c_{in}}{I} \left[\left(\frac{X1^{I}}{J} \sin Jy\right)\Big|_{Y1}^{Y2} - A^{I} g_{IJ}\right] \qquad j > 1 \qquad (11b)$$

In the equations for h_{ij},

$I = i-n+1$

$J = j-1$

$c_{in} = (i-1)\,!\; d^{n} \,/\, (i-1-n)\,!\; n\,!$

$A = Y_s/\sin\alpha$

The parameter, d, is a reference distance whose physical significance will be explained later.

Since the force calculations for the frustrum sections are more complicated than those for the cylindrical section, the two cases will be treated separately:

A. Cylindrical Sections

1. Engulfment Period

The force on the cylindrical section at some time, t, during the engulfment period is the integral of the pressure function over the area bounded by the curves:

$$\bar{\theta} = \text{arc cos } (Y_s/r_c), \qquad (12)$$

$$s = s_2, \qquad (12a)$$

$$s = s_1, \qquad (12b)$$

where s_1 and s_2 are the longitudinal distances of the end of the cylinder (see Figure 10). Thus, the force is calculated by:

$$F = \int_{s_1}^{s_2} \int_{0}^{\overline{\theta}} r_c p(s,\theta) d\theta ds \ . \tag{13}$$

Substituting equation (5) for $p(s,\theta)$ into equation (13), gives,

$$F = 2r_c \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \int_{s_1}^{s_2} \int_{0}^{\overline{\theta}} s^{i-1} \cos\left[(j-1)\theta\right] d\theta ds \tag{14}$$

or, using equation (9),

$$F = 2r_c \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} f_{i-1,j} (s_1, s_2, \overline{\theta}) \tag{14a}$$

2. Post Engulfment Period

During the post engulfment period the pressure function is integrated over the total sectional half area. Since for this case, $\overline{\theta} = \pi$,

$$F = 2r_c \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} f_{i-1,j} (s_1, s_2, \pi) \tag{15}$$

B. Frustrum Sections

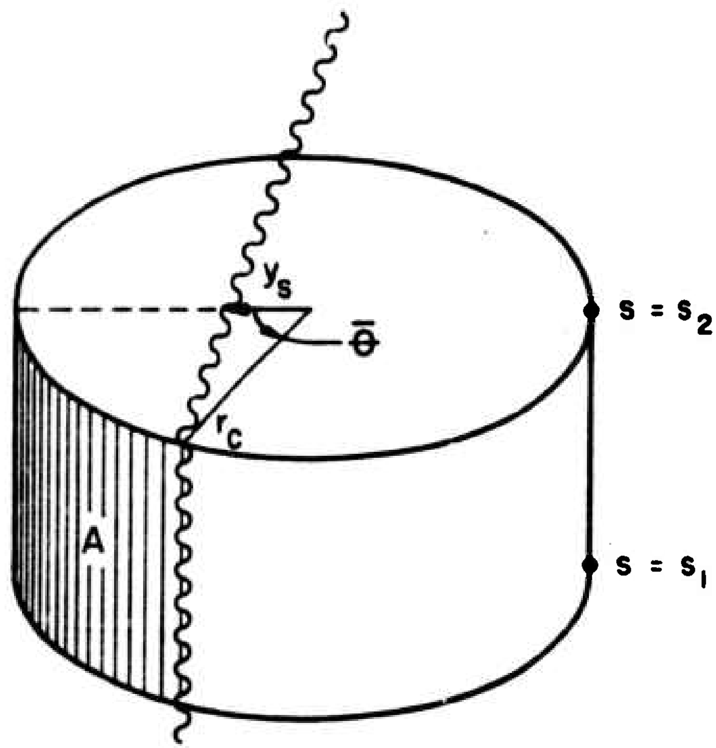
1. Engulfment Period

For a frustrum section, the area swept out by the shock is more easily visualized if the section is folded out. Since only the sectional half area is being considered (symmetry assumption), this area can be represented by a portion of a sector whose angle is $\beta_c = \pi \sin \alpha$ (see Figure 11a).

The shock boundary curve is then represented as a curve on the surface of the sector. The equation of this curve is, by equation (8),

$$\overline{R} = A \sec \overline{\theta} = A \sec (\overline{\beta}/\sin \alpha)$$

The second equality gives the boundary curve in terms of the polar coordinates $\overline{R}$ and β; where, $\overline{\beta}$ is defined as $\overline{\theta} \sin \alpha$. A folded out



INTEGRATION AREA FOR A CYLINDRICAL SECTION

FIGURE 10

frustrum section is shown in Figure 11 for various stages of engulfment. The subscript, 1, refers to the small end of the section; while, the subscript, 2, refers to the large end. The quantities, $r_1 = R_1 \sin \alpha$ and $r_2 = R_2 \sin \alpha$, are the radii of the small and large end of the section, respectively. The quantities:

$$\bar{\theta}_L = \text{arc cos } (Y_s/r_1) \text{ ,} \tag{17}$$

$$\bar{\theta}_u = \text{arc cos } (Y_s/r_2) \text{ ,} \tag{18}$$

$$\bar{R}_L = A \sec \theta_L \text{ .} \tag{19}$$

define the end points of the shock boundary curve. Equations (17) and (18) can be written in terms of the polar angles, $\bar{\beta}_L$ and $\bar{\beta}_u$ by multiplying these equations by $\sin \alpha$. The polar coordinates of the end points of the boundary curve are given in Figure 11 for each stage of engulfment shown. Since the pressure function, $p(s,\theta)$ is dependent upon s, and since the area of a frustrum section is most conveniently expressed in terms of R, the relation between s and R must be used to express both quantities in terms of the same variable. This relation is,

$$R = s + d \text{ ,} \tag{20}$$

where d is defined as, $R_1 - s_1$.

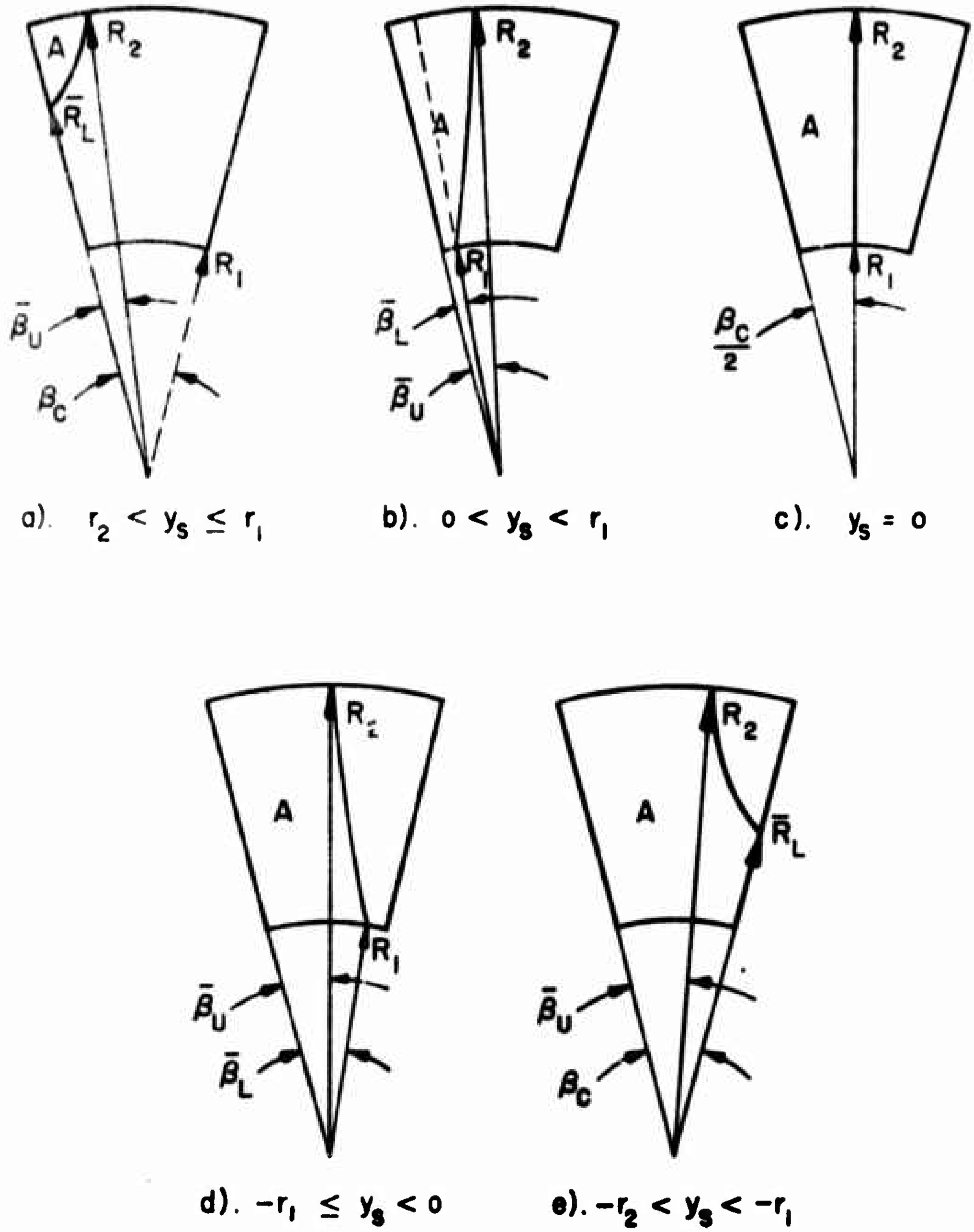
The force calculations for each of the engulfment stages of Figure 11 are described below:

a. $\underline{r_2 < Y_s \leq r_1}$

Referring to Figure 11a,

$$F = 2 \int_0^{\bar{\beta}_u} \int_{\bar{R}}^{R_2} p(s,\theta) \, RdRd\beta \tag{21}$$

$$F = 2 \sin \alpha \int_0^{\bar{\theta}_u} \int_{\bar{R}}^{R_2} p(s,\theta) \, RdRd\theta \text{ .} \tag{21a}$$



INTEGRATION AREAS OF A FRUSTRUM SECTION

FOR VARIOUS STAGES OF ENGULFMENT

FIGURE 11

Substituting equation (5) for $p(s,\theta)$ gives,

$$F = 2 \sin \alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \int_{0}^{\bar{\theta}_u} \int_{A\sec\bar{\theta}}^{R_2} (R-d)^{i-1} \cos\left[(j-1)\theta\right] RdRd\theta \quad (21b)$$

or using equation (11),

$$F = 2 \sin \alpha \sum_{i=1}^{K} \sum_{j=1}^{L} h_{ij} \, (0,\bar{\theta}_u,R_2) \quad (21c)$$

b. $0 < Y_s < r_1$

Referring to Figure 11b,

$$F = 2 \sin \alpha \left[\int_{0}^{\bar{\theta}_L} \int_{R_1}^{R_2} p(s,\theta) RdRd\theta + \int_{\theta_L}^{\bar{\theta}_u} \int_{A\sec\bar{\theta}}^{R_2} p(s,\theta) RdRd\theta \right] \quad (22)$$

Using equations (5) and (20), gives,

$$F = 2 \sin \alpha \left\{ \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \left[\int_{0}^{\bar{\theta}_u} \int_{R_1}^{R_2} s^{i-1} \cos\left[(j-1)\theta\right] (s+d) ds d\theta \right. \right. \quad (22a)$$

$$\left. \left. + \int_{\theta_L}^{\bar{\theta}_u} \int_{A\sec\bar{\theta}}^{R_2} (R-d)^{i-1} \cos\left[(j-1)\theta\right] RdRd\theta \right] \right\}.$$

The first integral can be written in terms of f_{ij} by equation (9). The second integral can be written in terms of h_{ij} by equation (10). Thus,

$$F = 2 \sin \alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \left[f_{ij}(\bar{\theta}_L, R_1, R_2) + df_{i-1,j}(\bar{\theta}_L, R_1, R_2) \right. \quad (22b)$$

$$\left. + h_{ij}(\bar{\theta}_L, \bar{\theta}_u, R_2) \right].$$

c. $\underline{Y_s = 0}$

Referring to Figure 11c,

$$F = 2 \sin \alpha \int_0^{\pi/2} \int_{R_1}^{R_2} p(s,\theta)\, R dR d\theta \qquad (23)$$

or using equations (5), (20) and (9),

$$F = 2 \sin \alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \left[f_{ij}(\pi/2, R_1, R_2) + df_{i-1,j}(\pi/2, R_1, R_2) \right] \qquad (23a)$$

d. $\underline{-r_1 \leq Y_s < 0}$ [3]

Referring to Figure 11d,

$$F = 2 \sin \alpha \left[\int_0^{\bar{\theta}_u} \int_{R_1}^{R_2} p(s,\theta) R dR d\theta + \int_{\bar{\theta}_L}^{\bar{\theta}_u} \int_{A \sec \bar{\theta}}^{R_1} p(s,\theta) R dR d\theta \right]. \qquad (24)$$

Using equations (5), (20), (9), and (10) gives,

$$F = 2 \sin \alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \left[f_{ij}(\bar{\theta}_u, R_1, R_2) + df_{i-1,j}(\bar{\theta}_u, R_1, R_2) \right. \qquad (24a)$$

$$\left. + h_{ij}(\bar{\theta}_L, \bar{\theta}_u, R_1) \right]$$

e. $\underline{-r_2 < Y_s < -r_1}$

Referring to Figure 11e, one sees that $\bar{R}_L = \pi/\sin \alpha$ and that $\bar{\theta}_L = \pi$; thus,

$$F = 2 \sin \alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \left[f_{ij}(\bar{\theta}_u, R_1, R_2) + df_{i-1,j}(\bar{\theta}_u, R_1, R_2) \right. \qquad (25)$$

$$\left. + h_{ij}(\pi, \bar{\theta}_u, \bar{R}_L) \right]$$

---

[3]Recall that Y_s changes sign after the shock passes the center of the section. This is true by the definition of Y_s.

2. Post Engulfment Period

During the post engulfment period, the pressure integration is performed around the total half sectional area. Thus, the force is calculated by the equation,

$$F = 2 \sin \alpha \int_{0}^{\pi} \int_{R_1}^{R_2} p(s,\theta)\, R dR d\theta \qquad (26)$$

or using equations (5), (20), and (9),

$$F = 2 \sin \alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \left[f_{ij}(\pi, R_1, R_2) + df_{i-1,j}(\pi, R_1, R_2) \right] \qquad (26a)$$

Therefore, by using equations (21) through (26), the forces for a given frustrum section can be calculated for both the engulfment and the post engulfment periods.

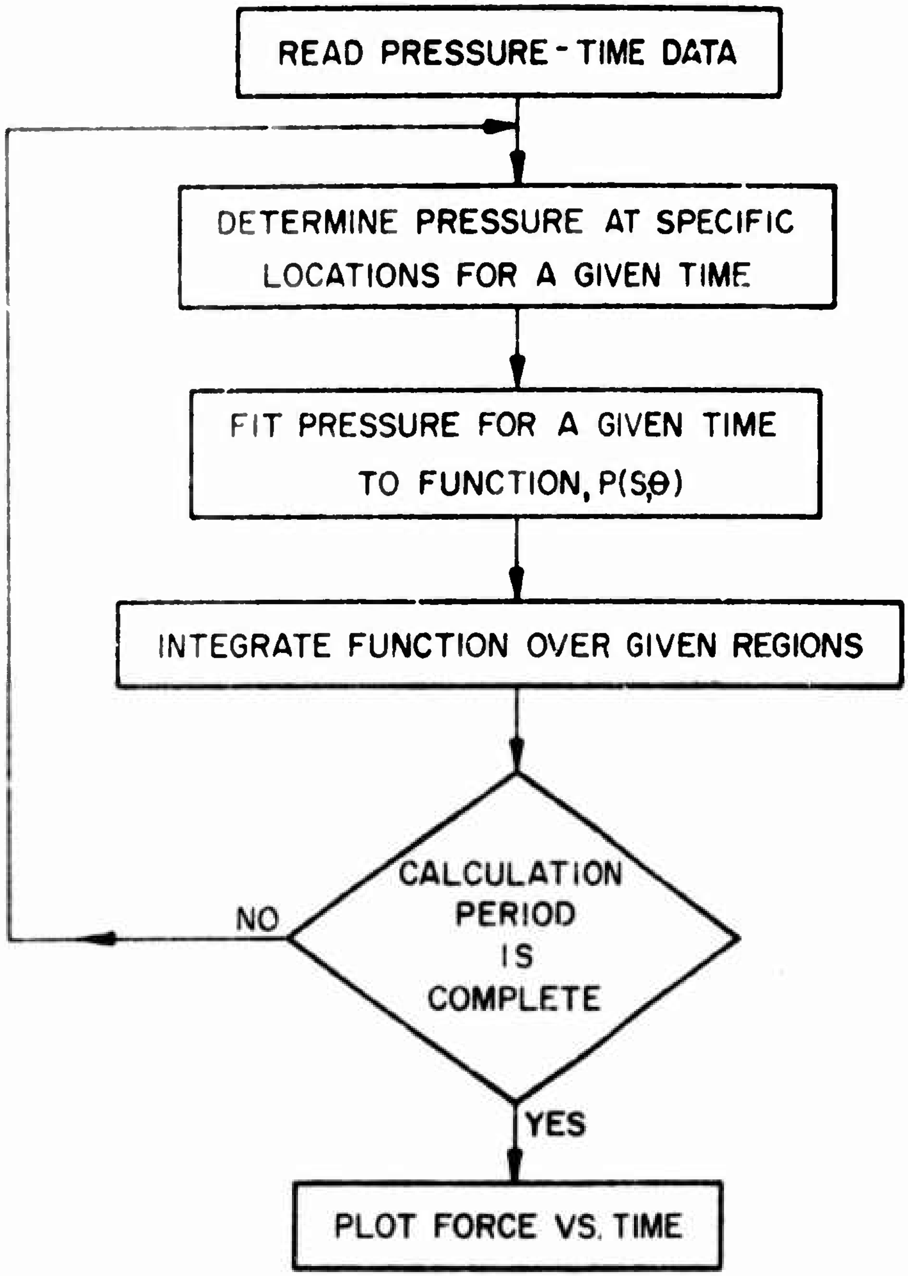
C. Description of Computer Program

The above results were used in a computer program for calculating the forces on given sections of the SPARTAN missile assembly. This program, named PREDIN, is written in extended FORTRAN IV for the NWL CDC 6700 computer. A basic flow chart of this program is given in Figure 12. This program takes pressure vs time data at given transducer locations in the form of punched cards, determines the pressure at each location for a given time, reads and appropriate limits K and L for the double summation of the pressure function, fits the data to the pressure function, integrates the obtained function over the appropriate sectional areas, and finally plots force-time histories for each missile assembly section of interest.

V. RESULTS

A. Results of Calculations

Using PREDIN, force calculations were obtained on sections 2, 3 and 4 of the missile assembly (see Figure 1) for DASACON tests 114-118. The calculations were performed on each section, at given times, for a total period of about seven milliseconds. Table 2 shows the calculation times for the engulfment period and the corresponding values of K and L for each test. Calculations were performed at intervals of .1 milliseconds during the post engulfment periods.



FLOW CHART FOR COMPUTER PROGRAM, PREDIN

FIGURE 12

TABLE 2

VALUES OF SUMMATION LIMITS FOR VARIOUS CALCULATION TIMES

Times Test 14 (msec)	Times Test 15 (msec)	Times Test 16 (msec)	Times Test 17 (msec)	Times Test 18 (msec)	K	L
.150	.150	.160	.200	.200	1	2
.550	.500	.550	.250	.600	2	2
.800	.700	.750	.600	.850	2	2
.900	.800	.900	.950	1.000	2	2
1.050	.900	1.000	1.100	1.150	3	3
1.625	1.450	1.500	1.700	1.750	3	4
2.225	2.000	2.050	2.300	2.350	3	5
2.850	2.600	2.600	3.100	2.950	3	6

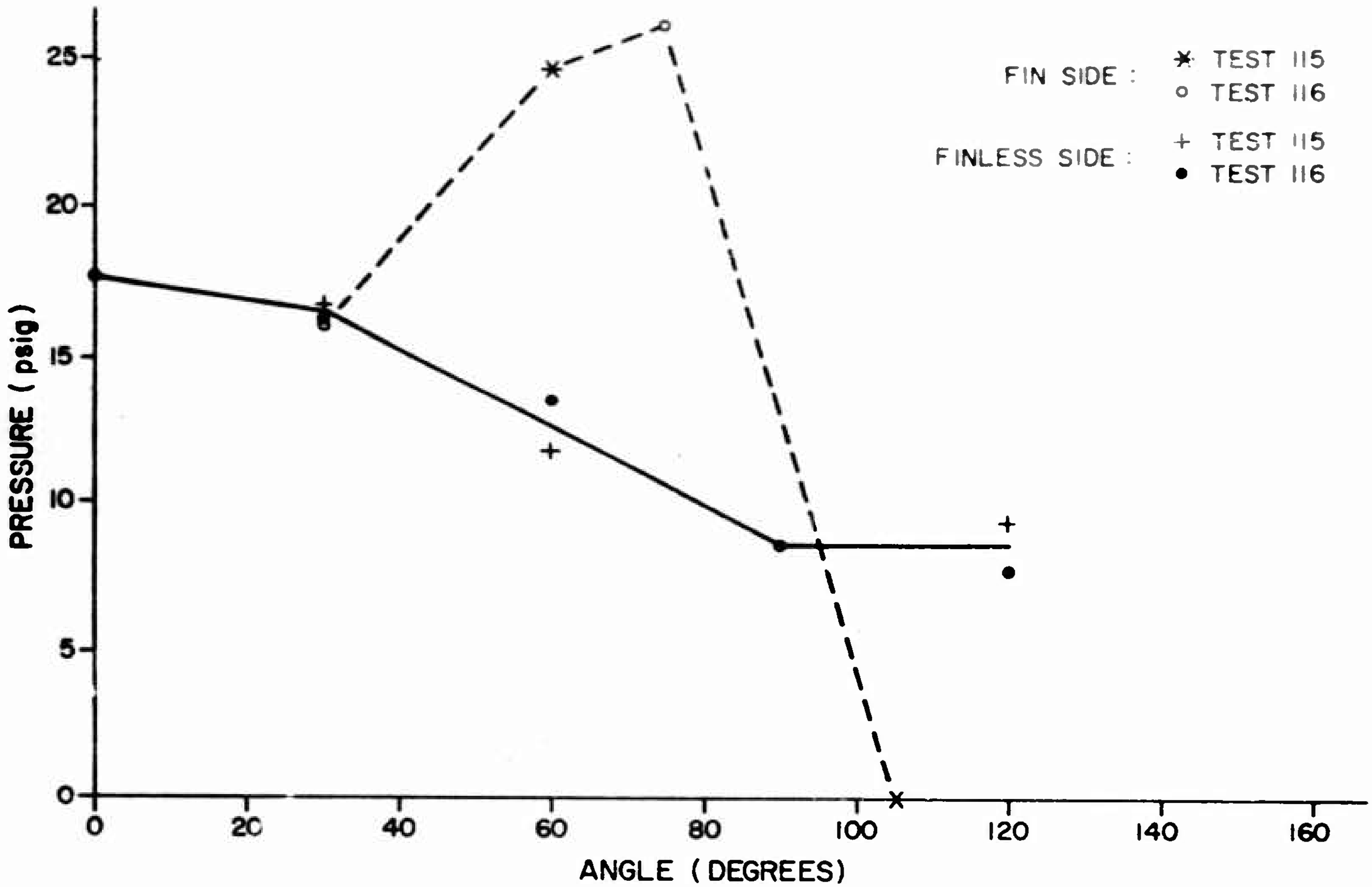
All times are referenced to the shock time of arrival at station P5-0 (see Figure 4). Tables of all of the b_{ij} coefficients of $p(s,\theta)$ are given for each calculation time of each test in Appendix C. Appendix D shows comparisons between pressures calculated by $p(s,\theta)$ and experimental data. The appendix contains experimental data from test 114 and 116. The comparisons for 114 are typical of tests 114, 117 and 118, and the comparisons for test 116 are typical of tests 115 and 116. Four times were chosen for these comparisons, two during the engulfment period and two during the post engulfment period. The solid lines in the figures were calculated by $p(s,\theta)$. The points are experimental data. Graphs of force vs time on sections 2, 3, and 4 of the missile assembly are given for each test in Appendix E. These curves are characterized by an initial fast rise, followed by a more gradual rise to a peak value, followed by a very gradual decay. The peak value occurs at a time approximately equal to the engulfment period of the section.

B. Effect of Fin

As discussed earlier, these results were obtained by assuming a symmetric pressure distribution. The effect of the fin on the pressure distribution of section 3 (control section) can be shown from the data of tests 115 and 116. These tests were conducted at approximately the same incident shock pressure (see Table 1). Because of the rotation of the missile assembly after test 115, the two tests gave pressure measurements at 30°, 60°, 75°, 105° and 150° on the fin side of section 3. Figures 13 through 16 show pressure data from the fin side vs angle compared with corresponding data on the finless side. The comparisons were made at times of 1.50, 2.00, 2.50 and 4.00 milliseconds, respectively. The data from the fin side are connected by dashed lines; while solid lines are drawn through the averages of the data from the finless side. These lines are drawn only to facilitate data reading. These figures clearly show the increased pressure due to the effects of the fin. These effects are smaller for section 2 and 4 which do not have a fin. An estimate of the percent differences between the forces calculated using the symmetry assumption and that of the actual pressure distribution can be obtained by the following procedure:

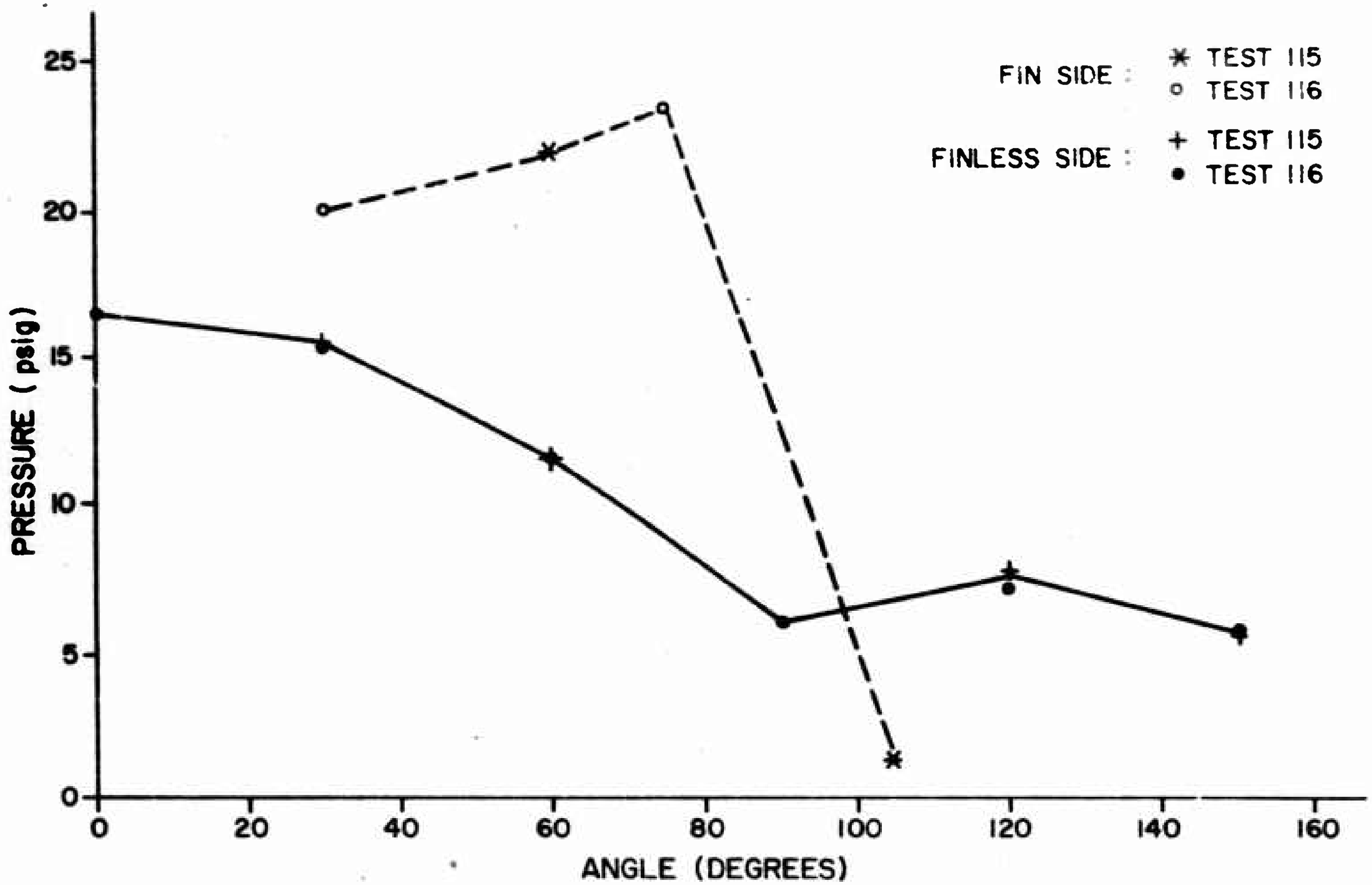
The force on section 3, at a given time, is estimated by multiplying the average of the pressure at the given time by the appropriate area. Thus, the force estimated without assuming a symmetrical pressure distribution is

$$F_a = (\bar{p}_F + \bar{p})\ A/2\ ; \qquad (27)$$



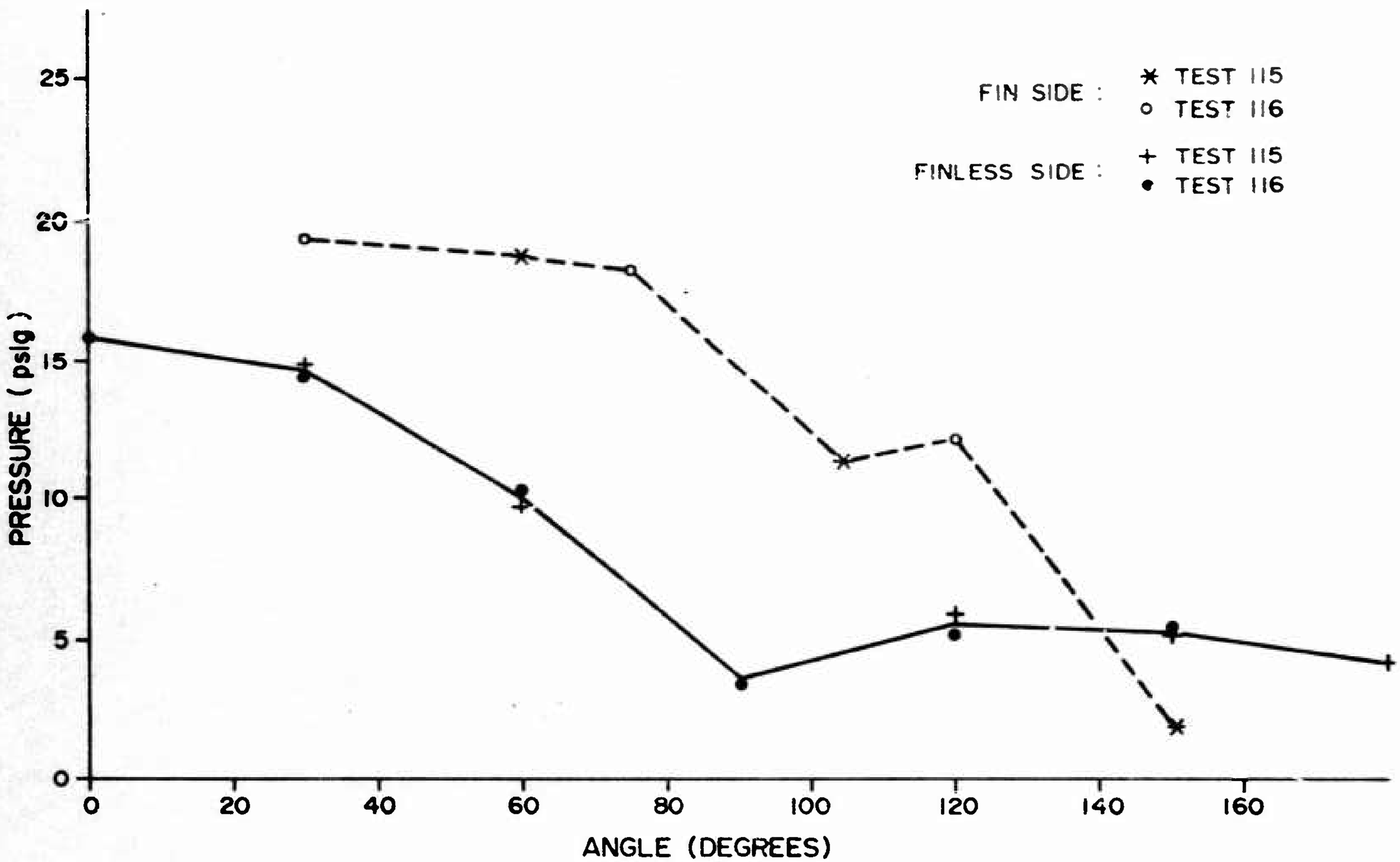
PRESSURE VS. ANGLE ON CONTROL SECTION — TIME = 1.50 MSEC

FIGURE 13



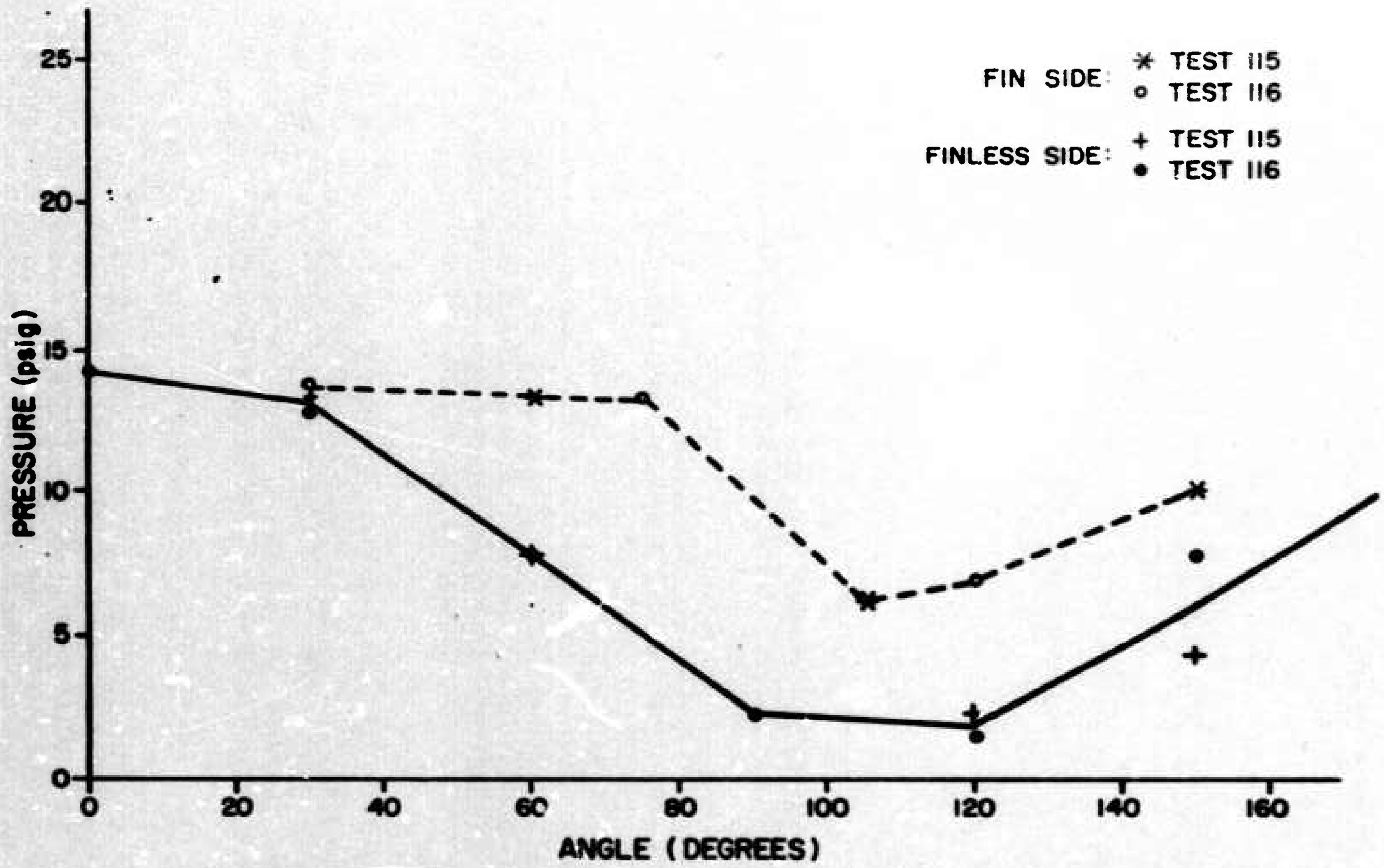
PRESSURE VS. ANGLE ON CONTROL SECTION — TIME = 2.00 MSEC

FIGURE 14



PRESSURE VS. ANGLE ON CONTROL SECTION — TIME = 2.50 MSEC

FIGURE 15



PRESSURE VS. ANGLE ON CONTROL SECTION — TIME = 4.00 MSEC

FIGURE 16

while, the force estimated with the symmetry assumption is

$$F = \overline{p}A \tag{28}$$

where, $\overline{p}_F$ is the average pressure on the fin side, and $\overline{p}$ is the average pressure on the finless side. A is the total area swept out by the shock wave. The ratio F_a/F is given by,

$$F_a/F = (\overline{p}_F + \overline{p})/2\overline{p} = (1 + \overline{p}_F/\overline{p})/2 \tag{29}$$

This ratio is plotted against time in Figure 17. The maximum value of the ratio occurs near the engulfment time. Figure 17, therefore, gives as estimate of the effect of assuming a symmetrical pressure distribution in the force calculations for section 3. This effect is expected to be less for sections 2 and 4 since they do not contain a fin.

VI. CONCLUSIONS AND RECOMMENDATIONS

The results of this report show that the pressure distribution at a given time on the surface of the SPARTAN missile assembly can be represented by the function,

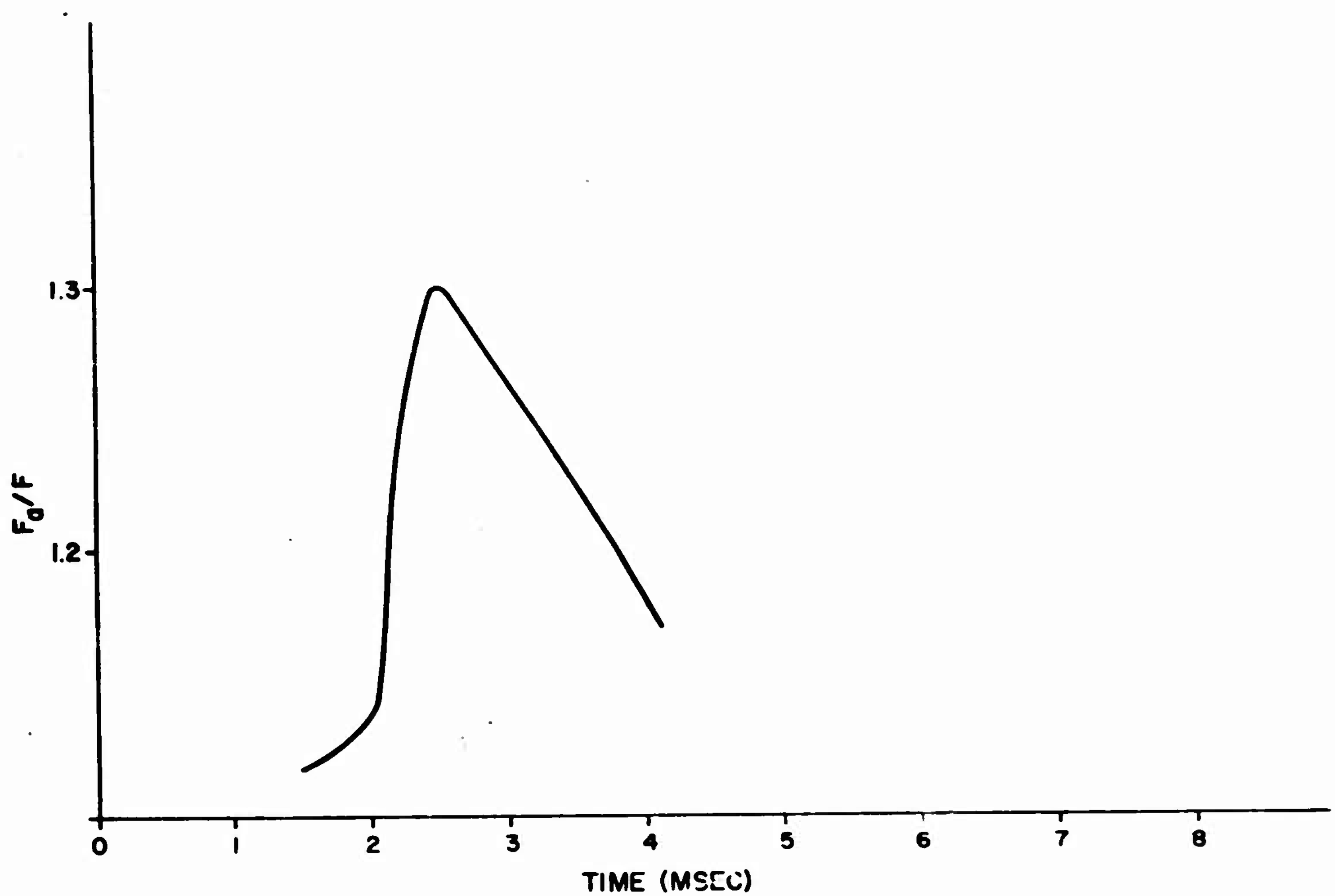
$$p(s,\theta) = \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij}\, s^{i-1} \cos\left[(j-1)\,\theta\right]$$

The coefficients and the number of terms in this representation depend upon the amount of experimental data available. For determining the forces on the missile assembly, the number of data points obtained during the DASACON tests were adequate. Analyses which require a more accurate definition of the pressure distribution would, in general, require more data.

The term, "force", used in this report applies to the integration of the above equation over the appropriate area. The actual directional forces on the various assembly sections could be obtained with the data presented and described in this report. For example, the directional forces on a given assembly section can be determined by,

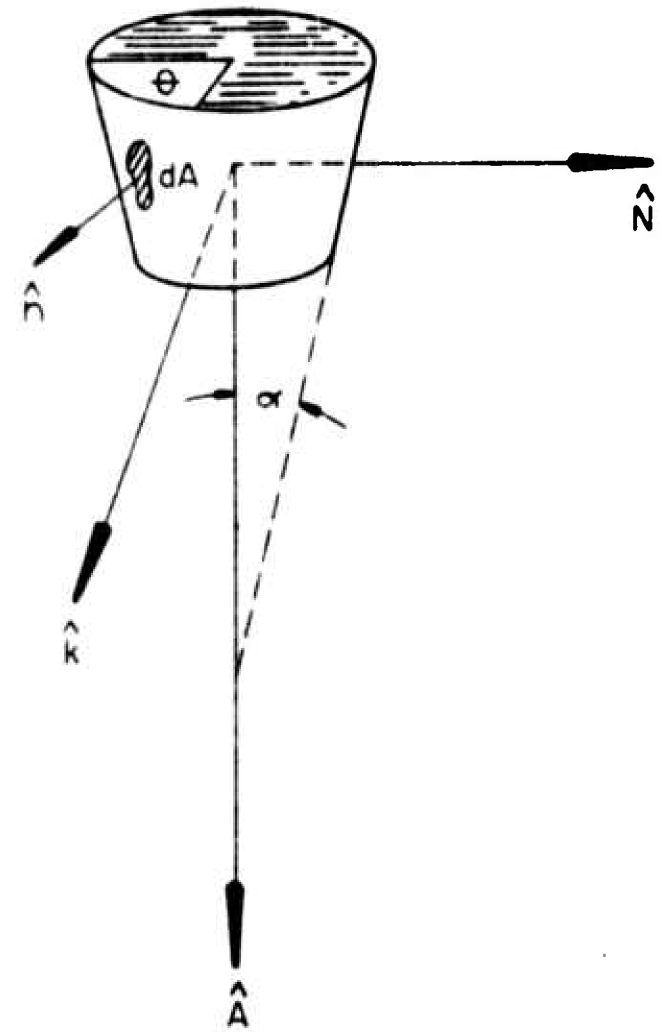
$$Fd = \int\int_{A(s,\theta)} -p(s,\theta)\, \hat{n}\, dA\ , \tag{30}$$

where $\hat{n}$ is a unit vector normal to the surface. Vector $\hat{n}$, can be expressed in terms of an orthogonal set of vectors $\hat{A}$, $\hat{N}$ and $\hat{K}$, shown in Figure 18 for a frustrum section. Unit vector $\hat{A}$ is directed along the



FORCE RATIO VS. TIME FOR CONTROL SECTION

FIGURE 17



UNIT NORMAL ON THE SURFACE
OF A
FUSTRUM SECTION

figure 18

sectional axis, $\hat{N}$ is directed perpendicular to the axis in the direction of the blast wave propagation, and $\hat{K}$ is directed out of the plane formed by $\hat{A}$ and $\hat{N}$. Thus, $\hat{n}$ can be written as,

$$\hat{n} = \cos\alpha\, \hat{A} - \sin\alpha \cos\theta\, \hat{N} + \sin\alpha \sin\theta\, \hat{K} \tag{31}$$

Since $p(s,\theta)$ is symmetrical about the plane perpendicular to K, the total force in the K direction must be zero. Substituting equations (5) and (31) into equation (30) gives:

$$F_A = \sin\alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \iint_{A(s,\theta)} s^{i-1} \cos\left[(j-1)\theta\right] \cos\theta \, dA \tag{32}$$

$$F_n = \cos\alpha \sum_{i=1}^{K} \sum_{j=1}^{L} b_{ij} \iint_{A(s,\theta)} s^{i-1} \cos\left[(j-1)\theta\right] dA \tag{33}$$

$$F_k = 0 \tag{34}$$

These are the vector force components for a frustrum section in the axial, normal and $\hat{K}$ directions respectively. Similar expressions for a cylindrical section are obtained by setting $\alpha = 0$ in the above equations. The same integration limits for the various stages of engulfment and the post engulfment period given in section IV can be used in evaluating the above integrals. Solutions to these integrals can be found in standard tables, although care must be taken to insure that all possible cases are considered.

The test results indicate that the presence of a fin on one side of the control section may cause the force on that section to be as much as 1.3 times as great as that encountered without a fin. This result indicates that a symmetrical distribution should not be assumed when a high degree of accuracy in the force calculations is desired. The same equation for fitting the data can be used for both the symmetrical and the asymmetrical distribution. However, the fit for the asymmetrical distribution requires more data to be taken on the fin side of the assembly. For this reason, it is recommended that, in the future, an equal number of pressure gauges be placed on each side of asymmetrically loaded test items.

NWL possesses a large amount of surface pressure data obtained from various blast loading tests on sectional assemblies of the Sprint and the Nike Hercules missiles, in addition to the SPARTAN data discussed in this report. These missile assemblies vary in size, but have the same basic shapes, i.e., cylinders, frustrums of cones. These data

include the results of tests performed over a wide range of incident shock pressures and missile orientations. It is recommended that a thorough aerodynamic and statistical analysis of the data be made. This analysis should lead to the formulation of an empirical pressure distribution model for the air blast loading of objects similar in shape to the missile assemblies.

REFERENCES

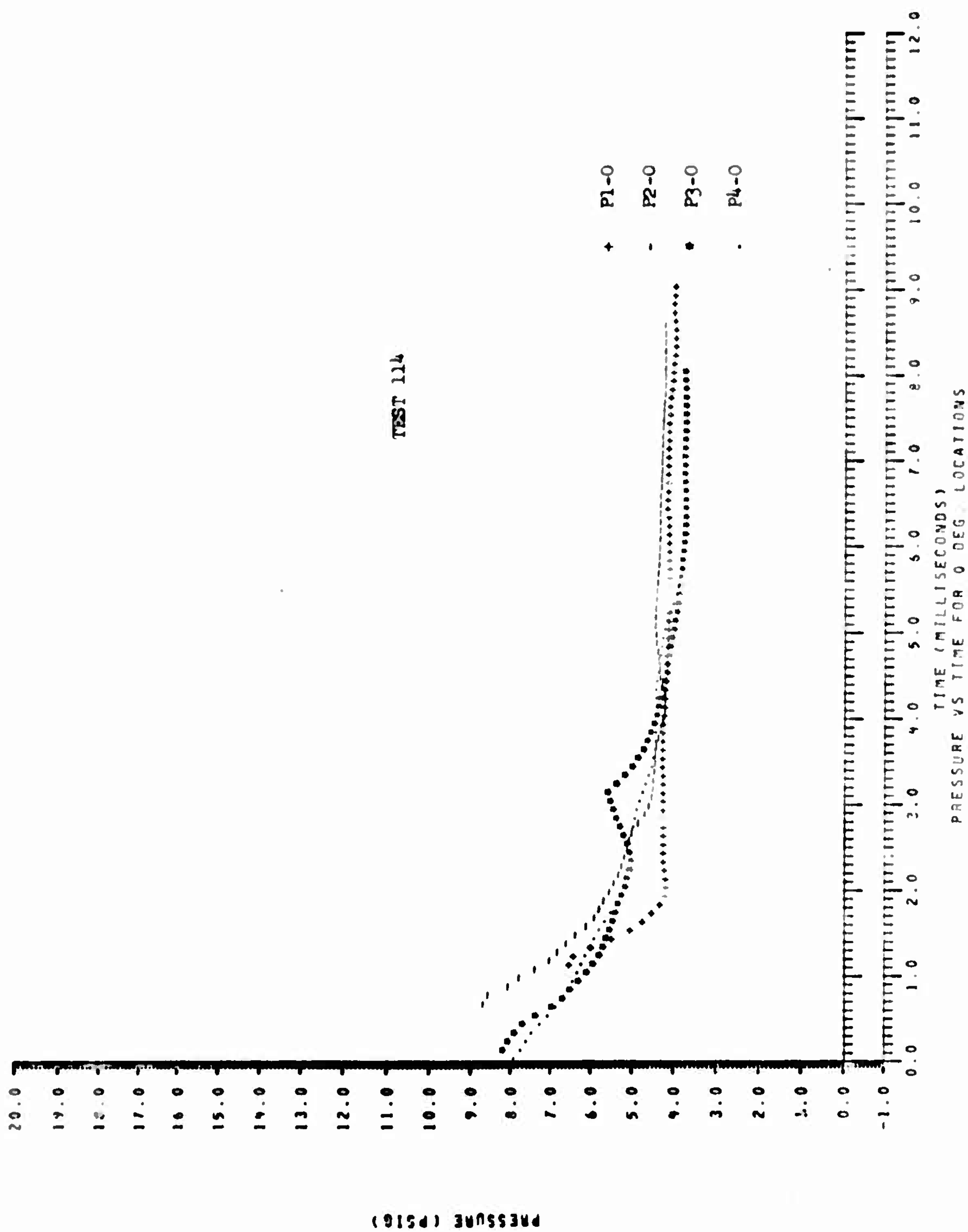
(a) Anderson, L. P., Jr., "Air Blast Loading Tests on a Spartan Missile Assembly in the NWL Conical Shock Tube," NWL TR-2826, November 1972.

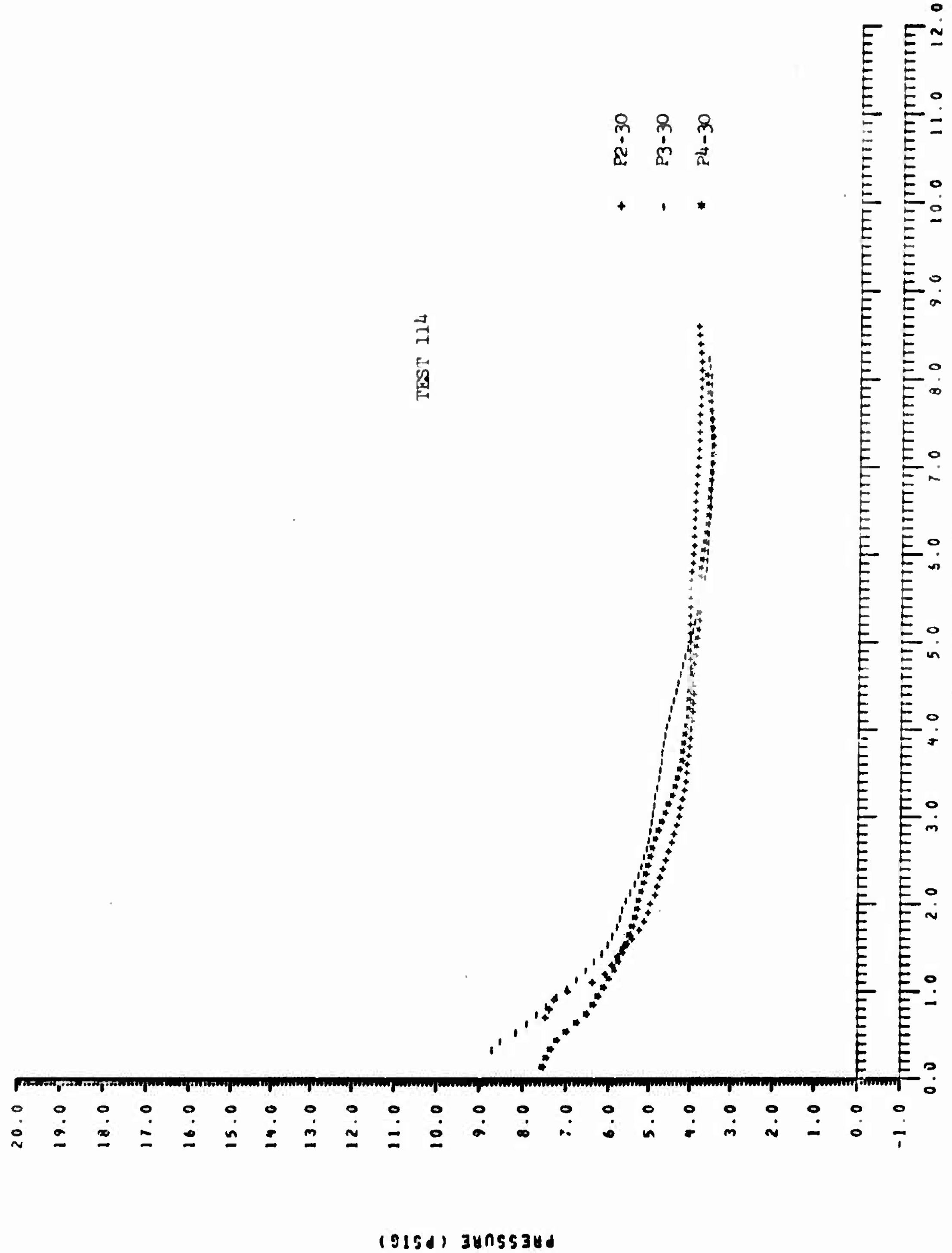
(b) Hollyer, R. H. and Duff, R. E., "The Effect of Wall Boundary Diffraction of Shock Waves Around Cylindrical and Rectangular Obstacles," Engineering Research Institute, University of Michigan, Report No. 50-2, June 1950.

(c) Courant, R. and Friedrichs, Supersonic Flow and Shock Waves, Interscience Publishers, Inc., New York, 1948.

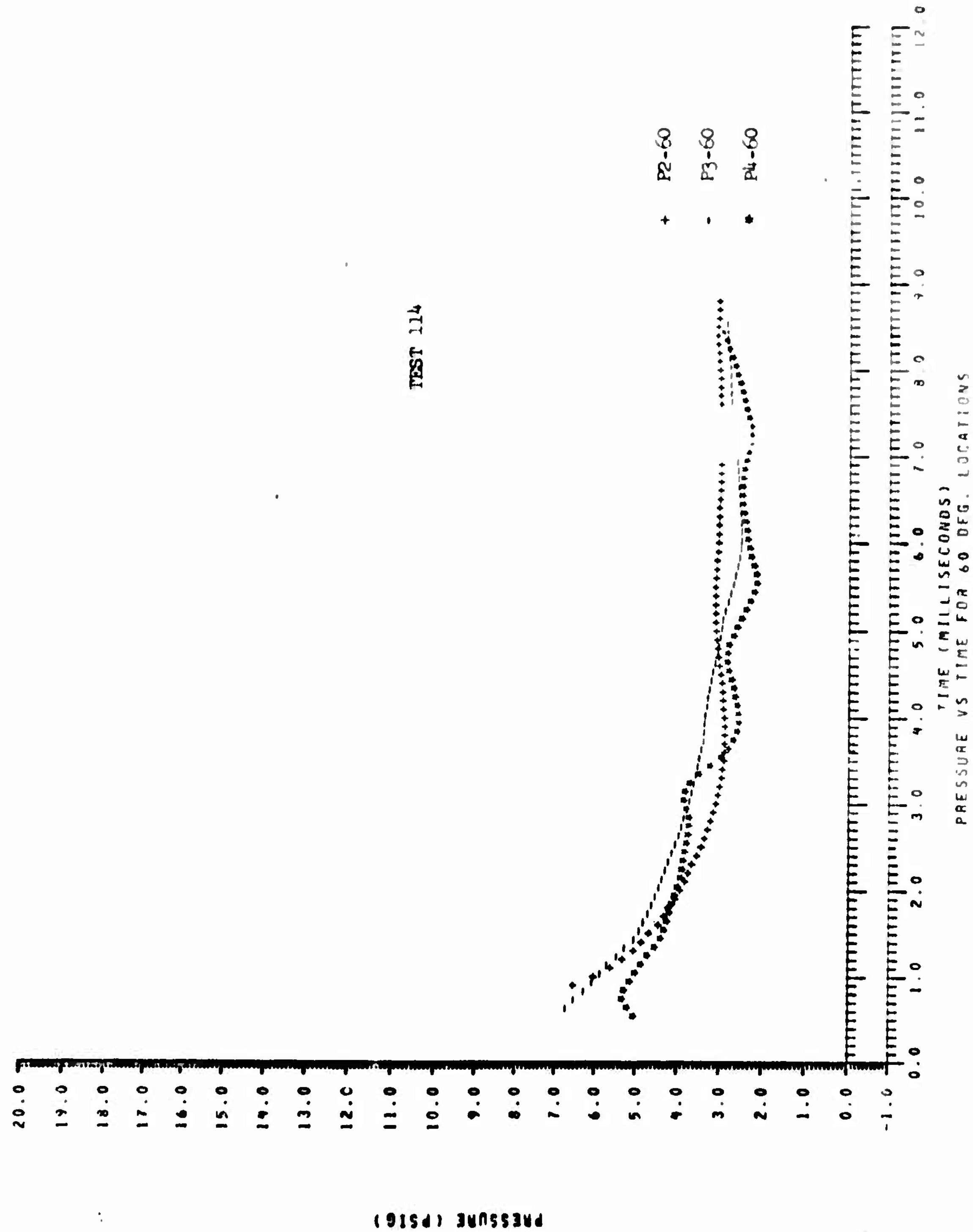
APPENDIX A

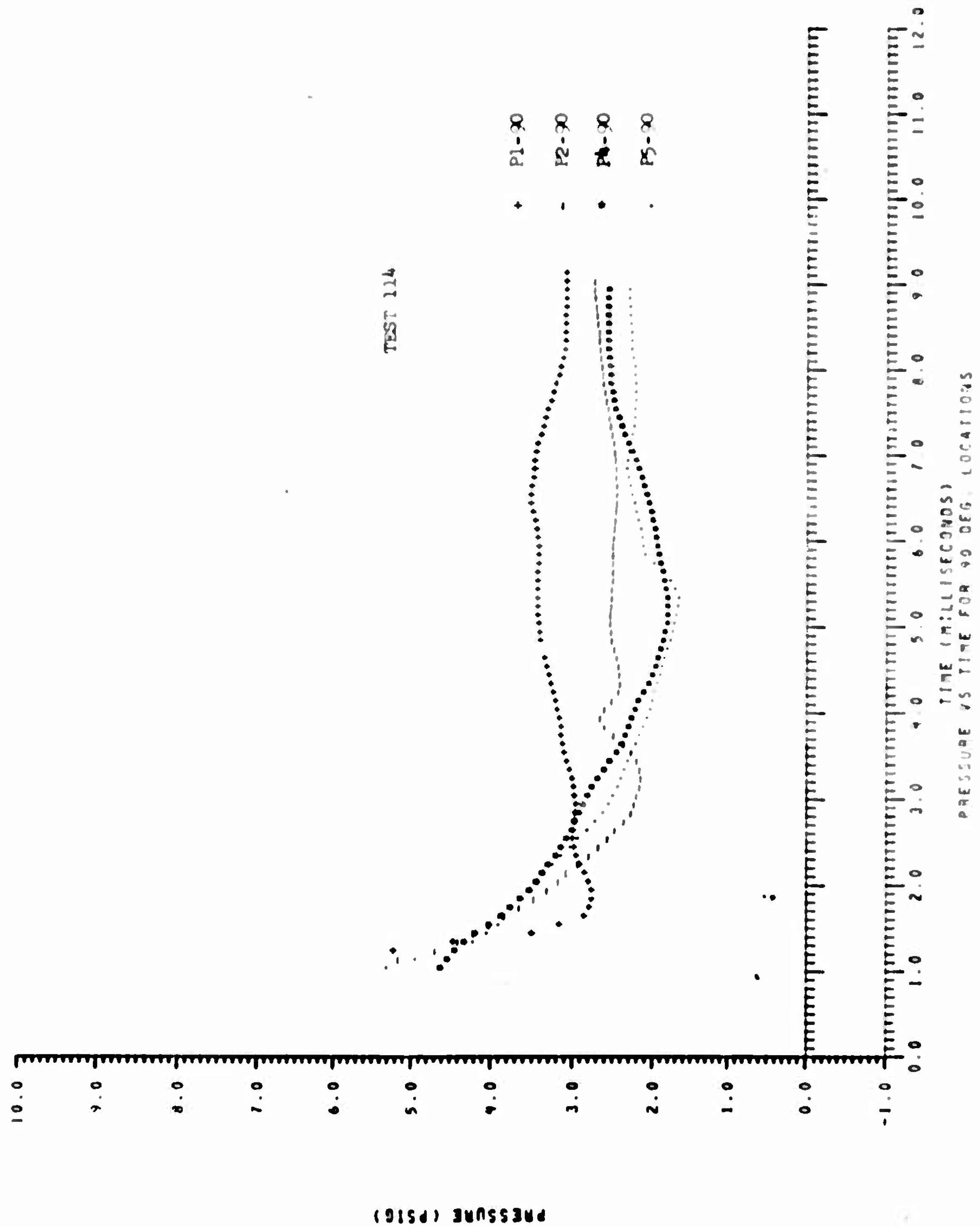
SMOOTHED PRESSURE-TIME HISTORIES


TEST 114
P1-0
P2-0
P3-0
P4-0
PRESSURE (PSIG)
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 0 DEG. LOCATIONS
20.0
19.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
0.0
-1.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0

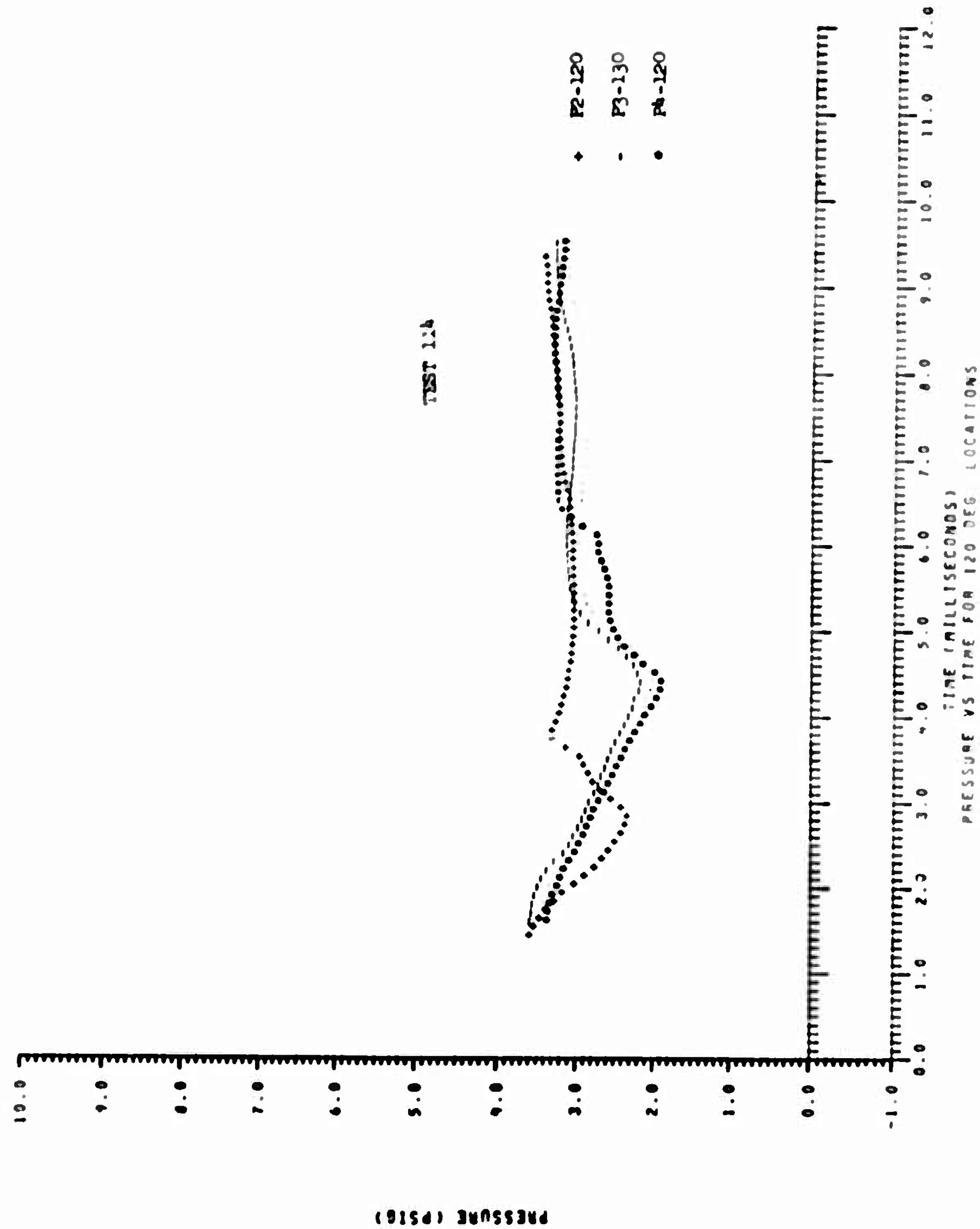


PRESSURE VS TIME FOR 30 DEG. LOCATIONS

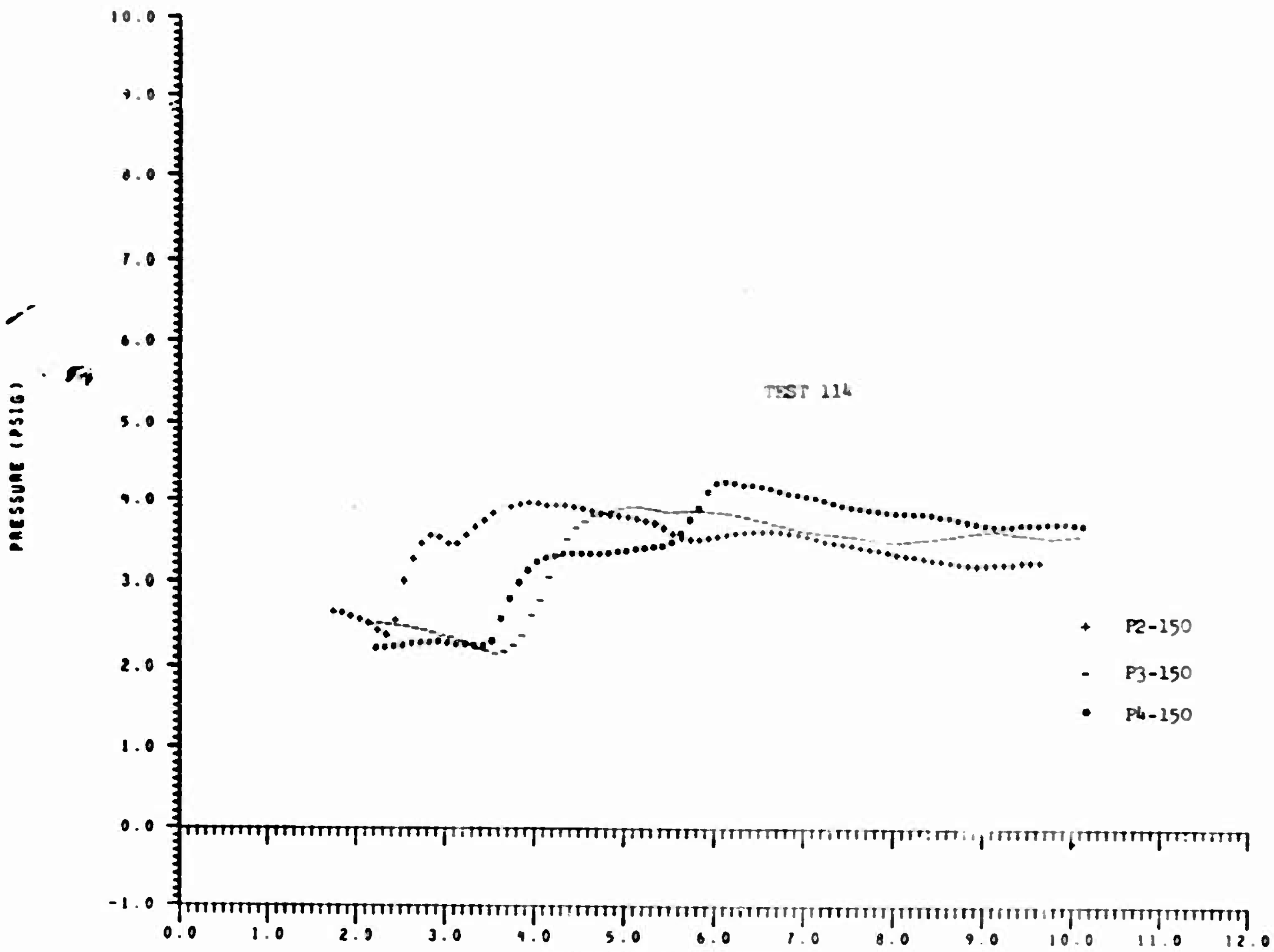

TEST 114
+ P2-60
- P3-60
* P4-60
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 60 DEG. LOCATIONS
PRESSURE (PSIG)



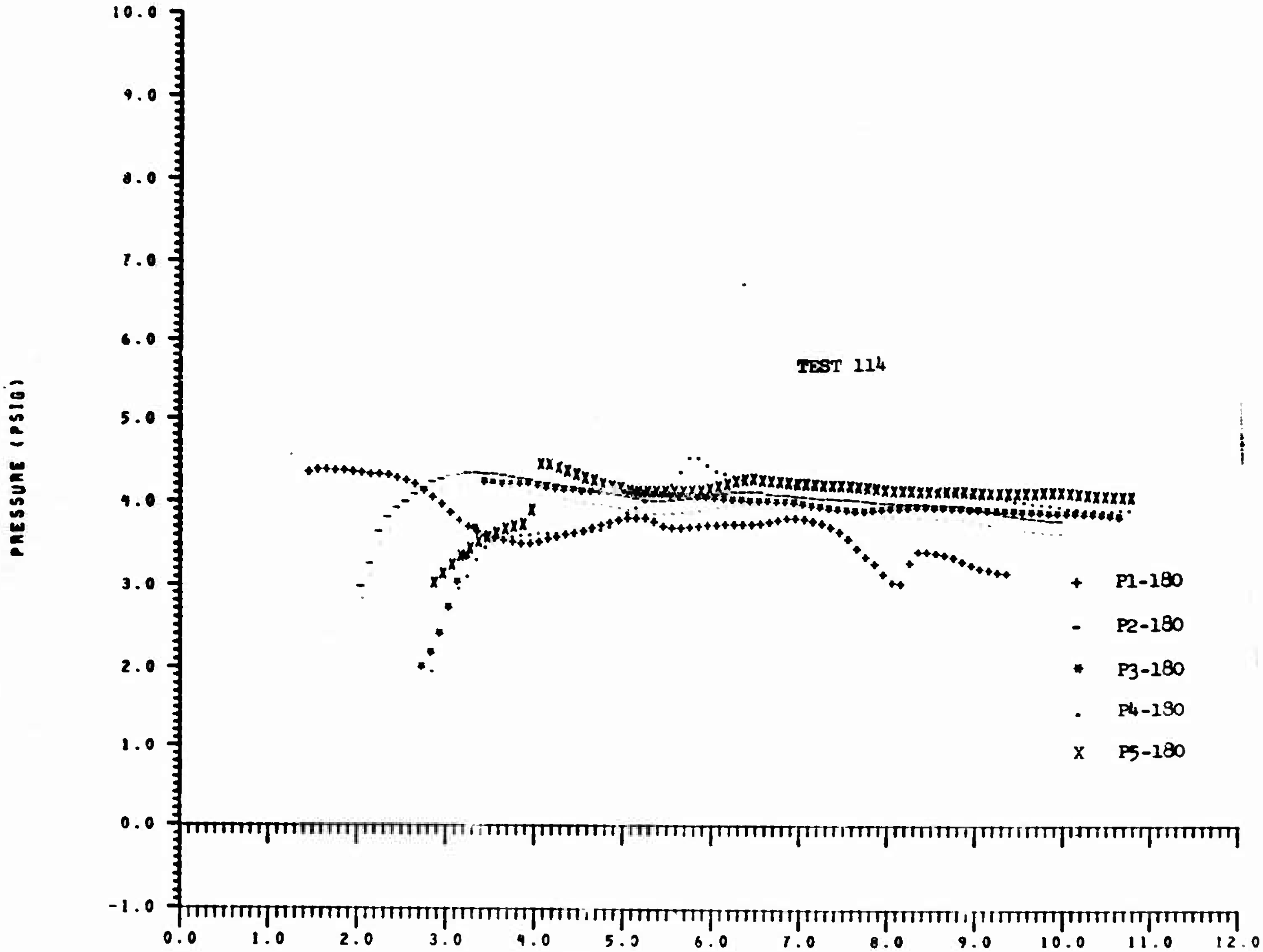
TEST 114
P1-90
P2-90
P4-90
P5-90
PRESSURE (PSIG)
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 90 DEG. LOCATIONS
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0



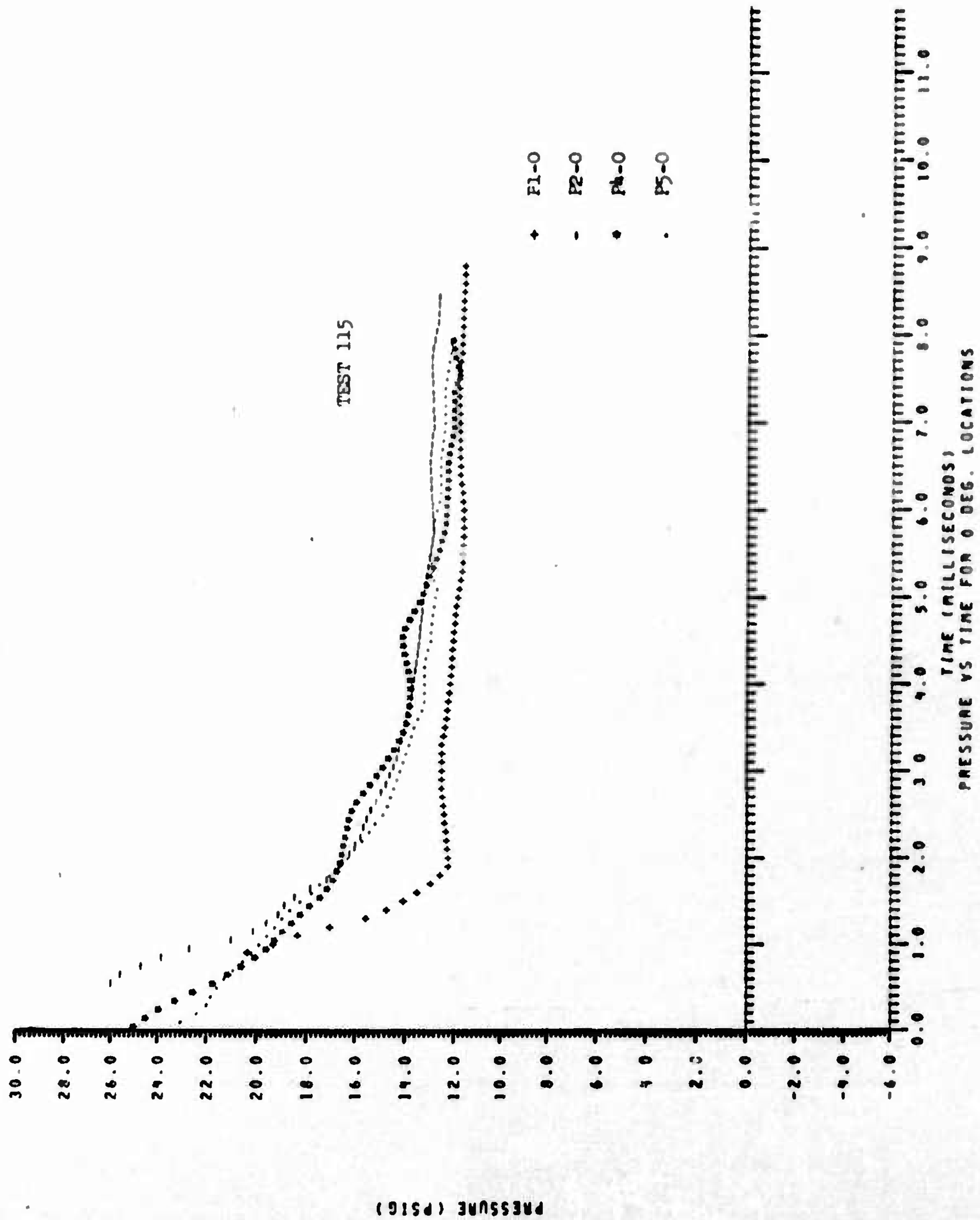
TEST 11b
P2-120
P3-130
P4-120
PRESSURE (PSIG)
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 120 DEG LOCATIONS

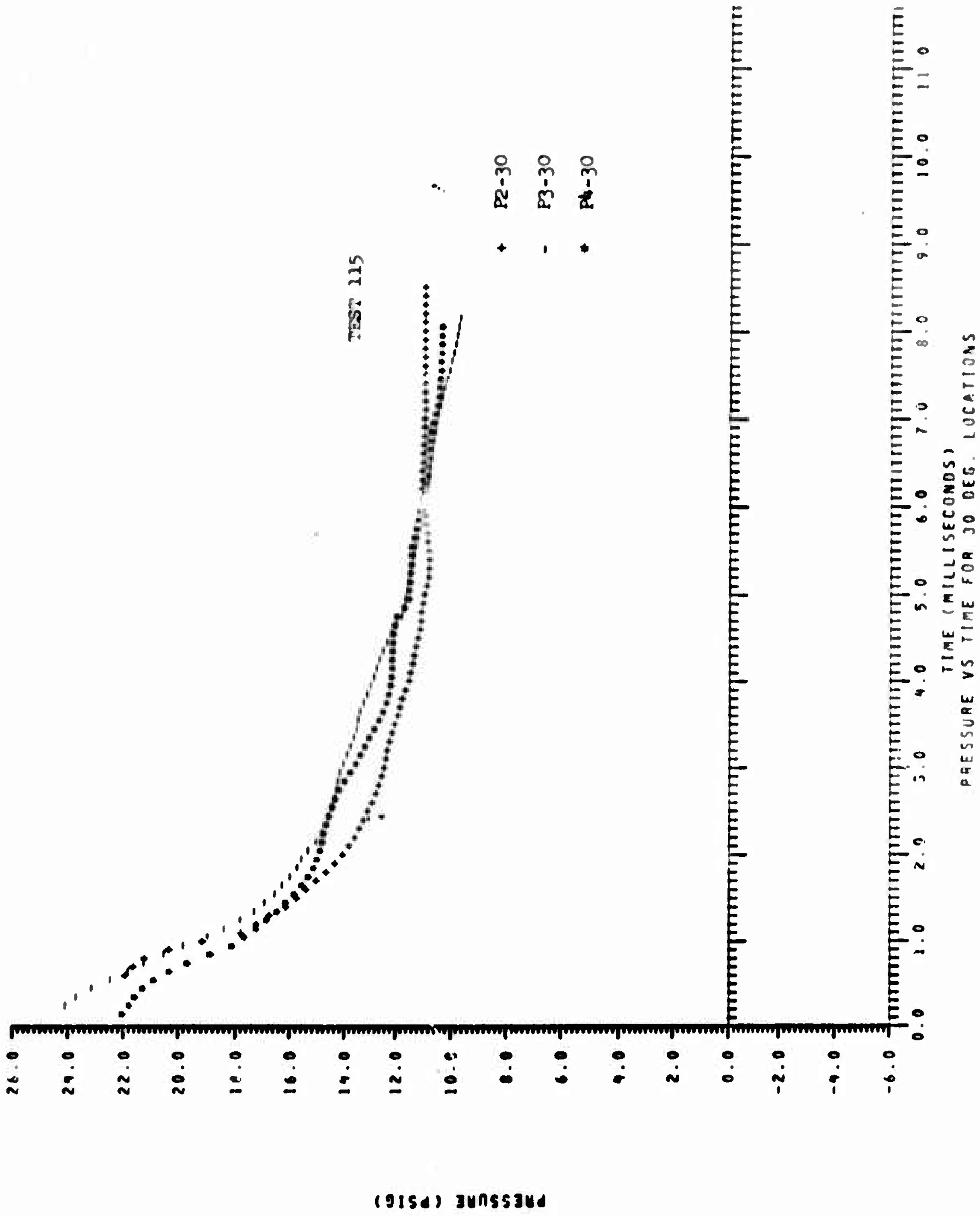


PRESSURE VS TIME FOR 150 DEG. LOCATIONS

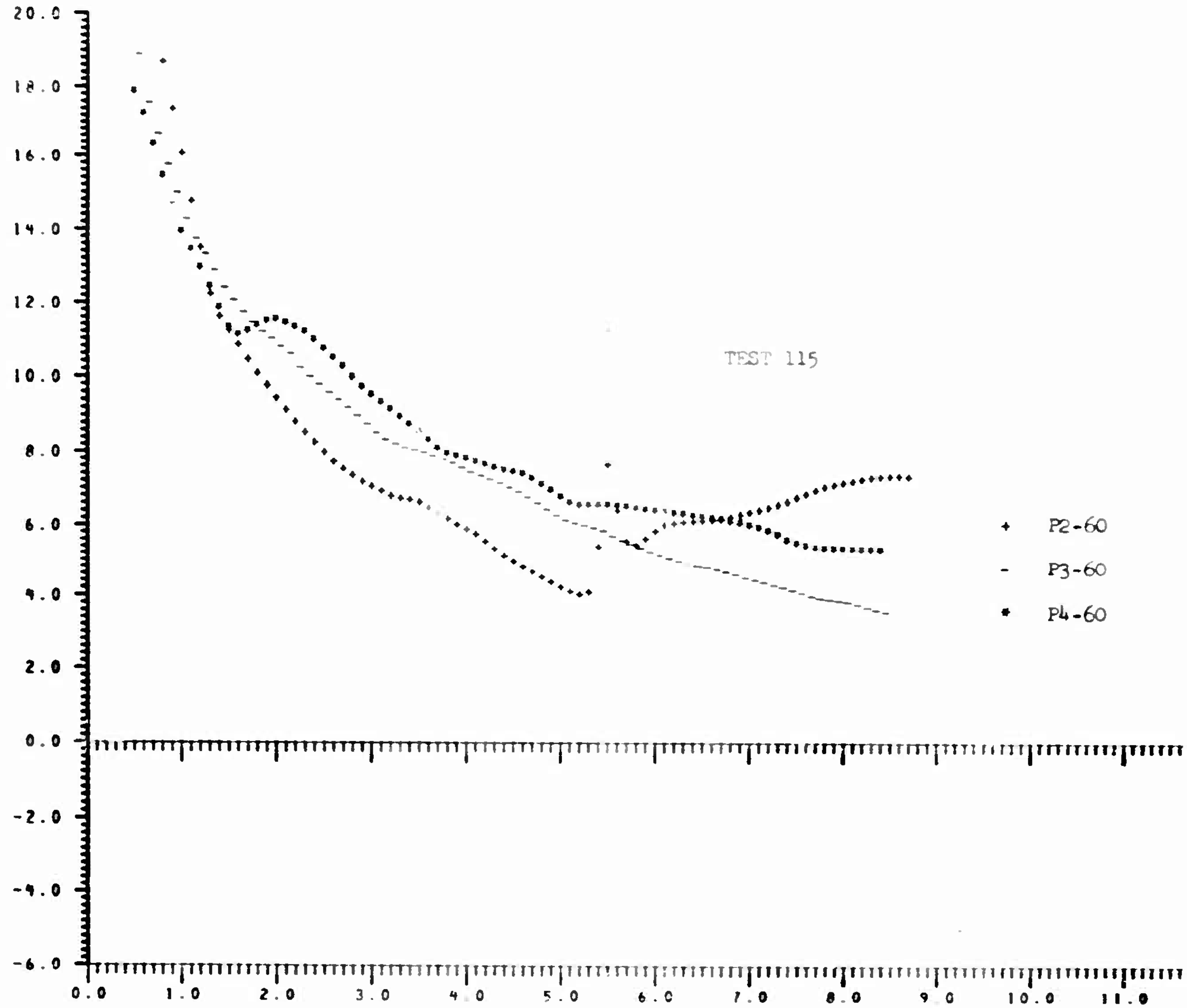


PRESSURE VS TIME FOR 180 DEG. LOCATIONS

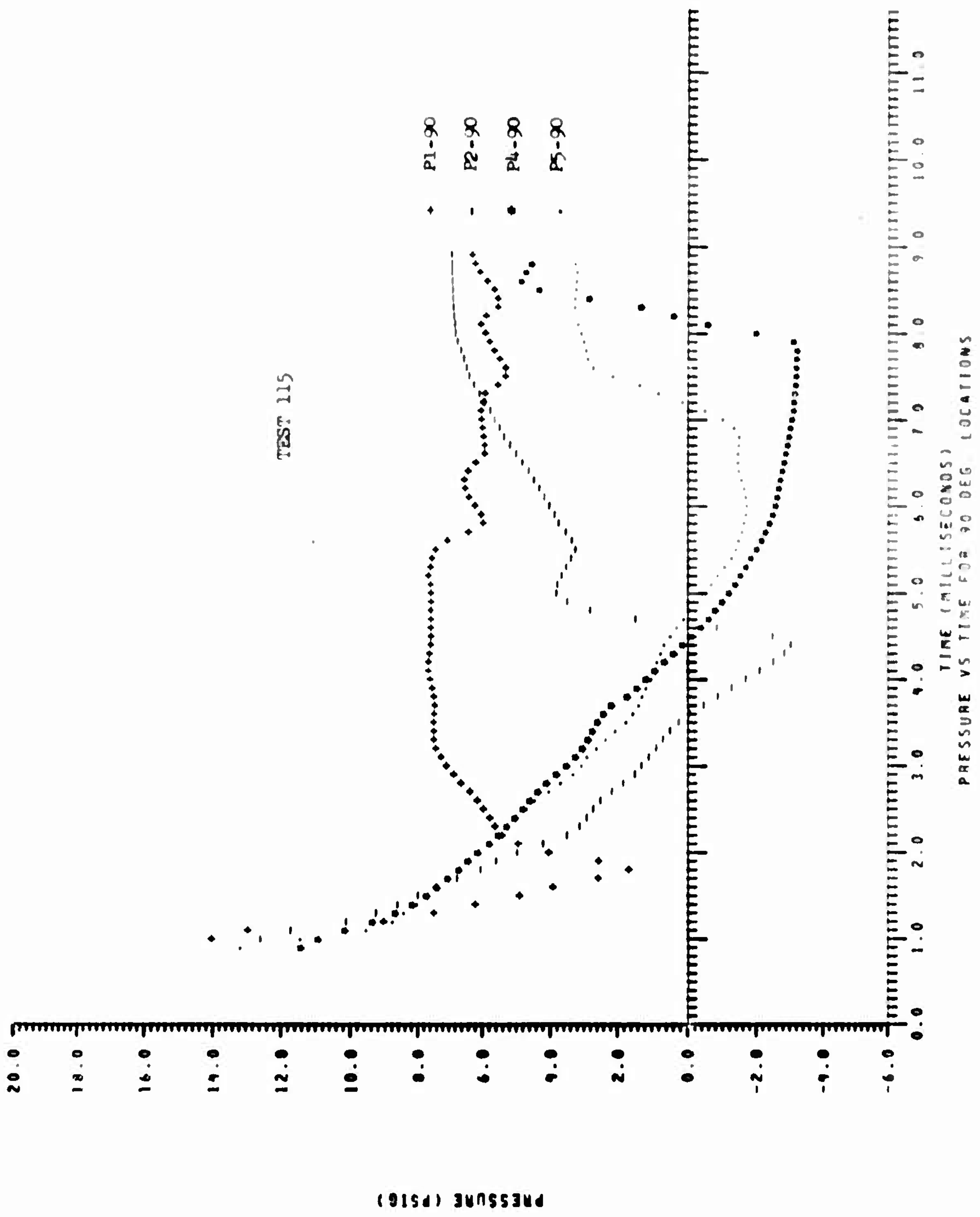

TEST 115
P1-O
P2-O
P4-O
P5-O
PRESSURE (PSIG)
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 0 DEG. LOCATIONS

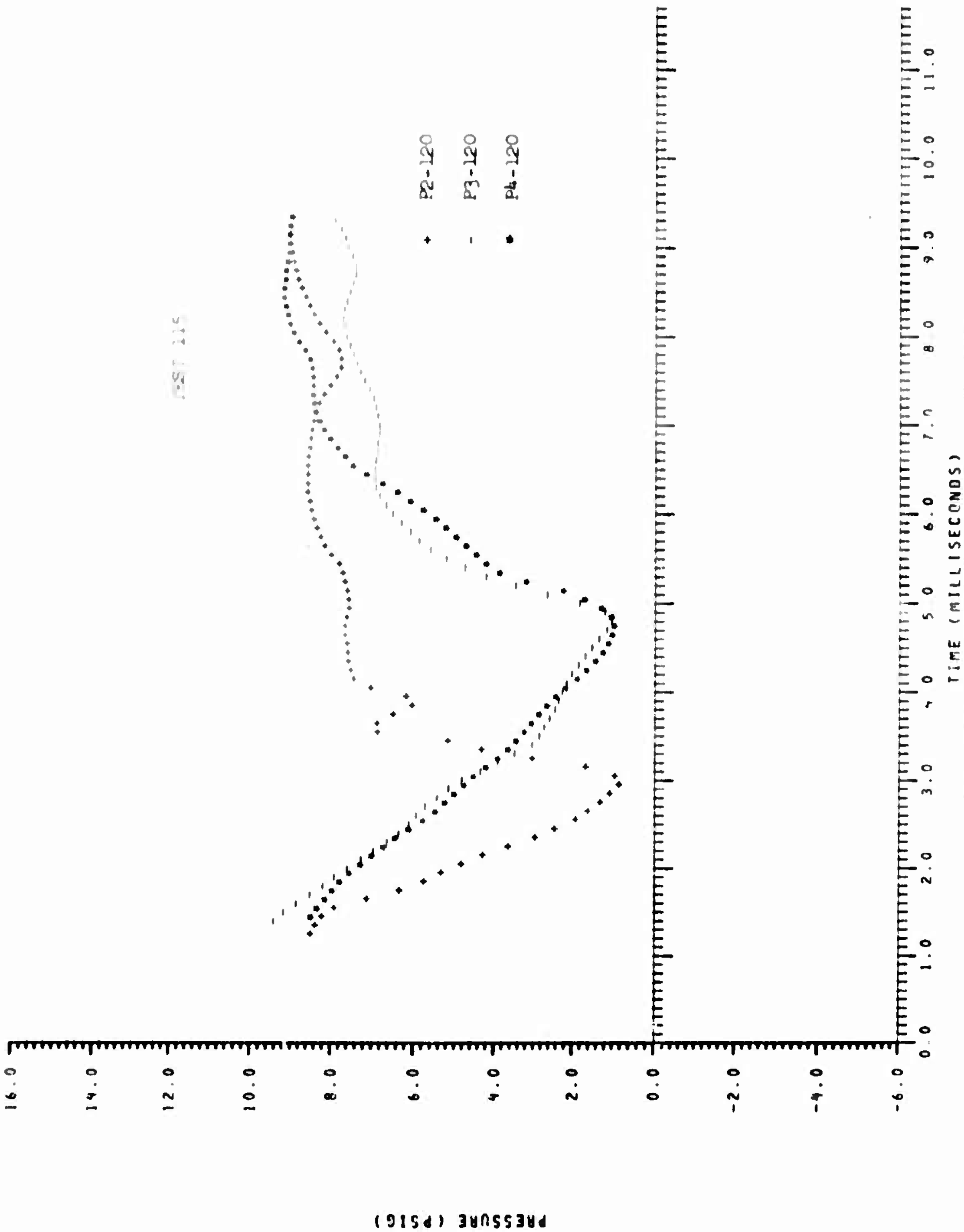


TEST 115
+ P2-30
- P3-30
* P4-30
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 30 DEG. LOCATIONS
PRESSURE (PSIG)

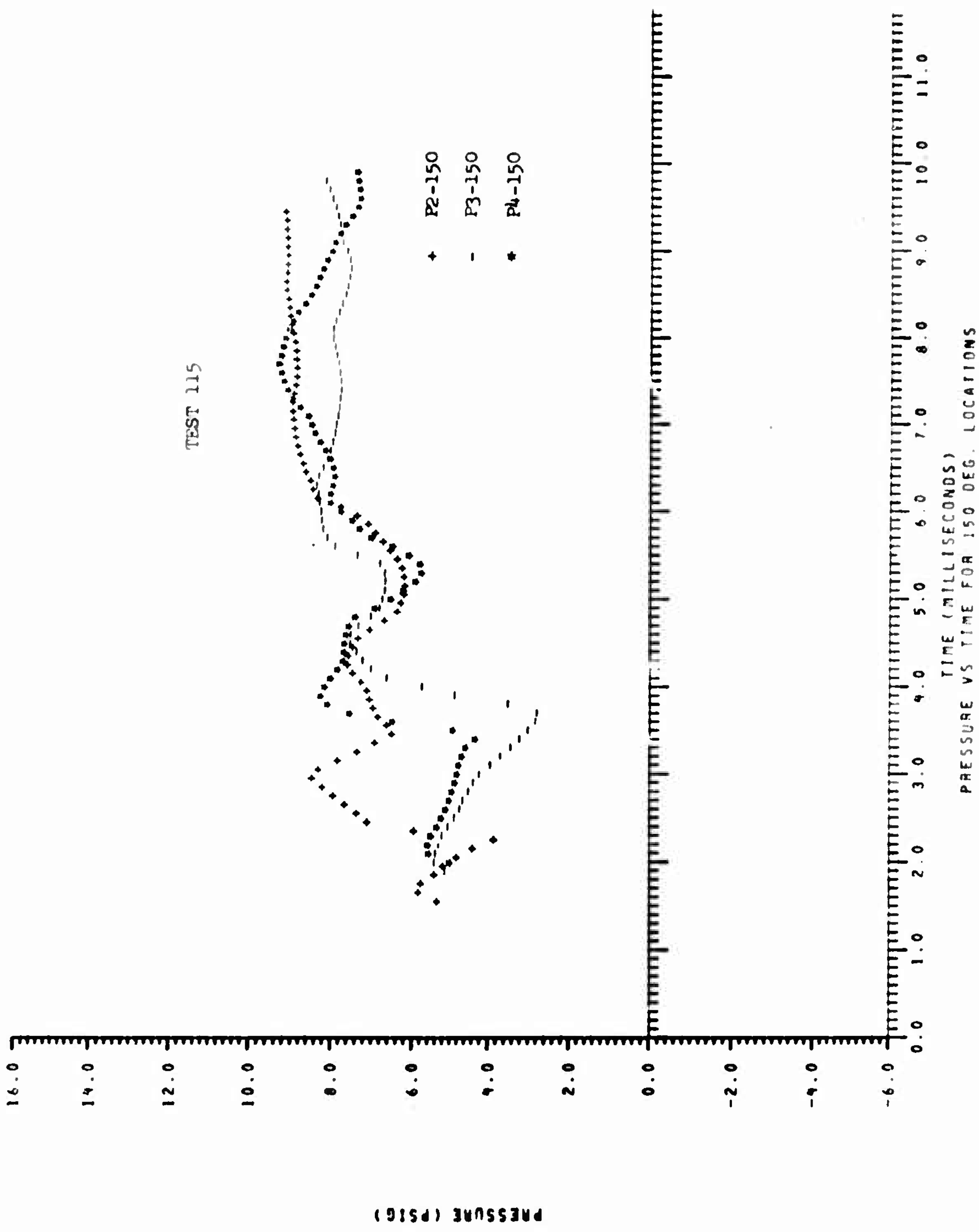


PRESSURE VS TIME FOR 60 DEG. LOCATIONS

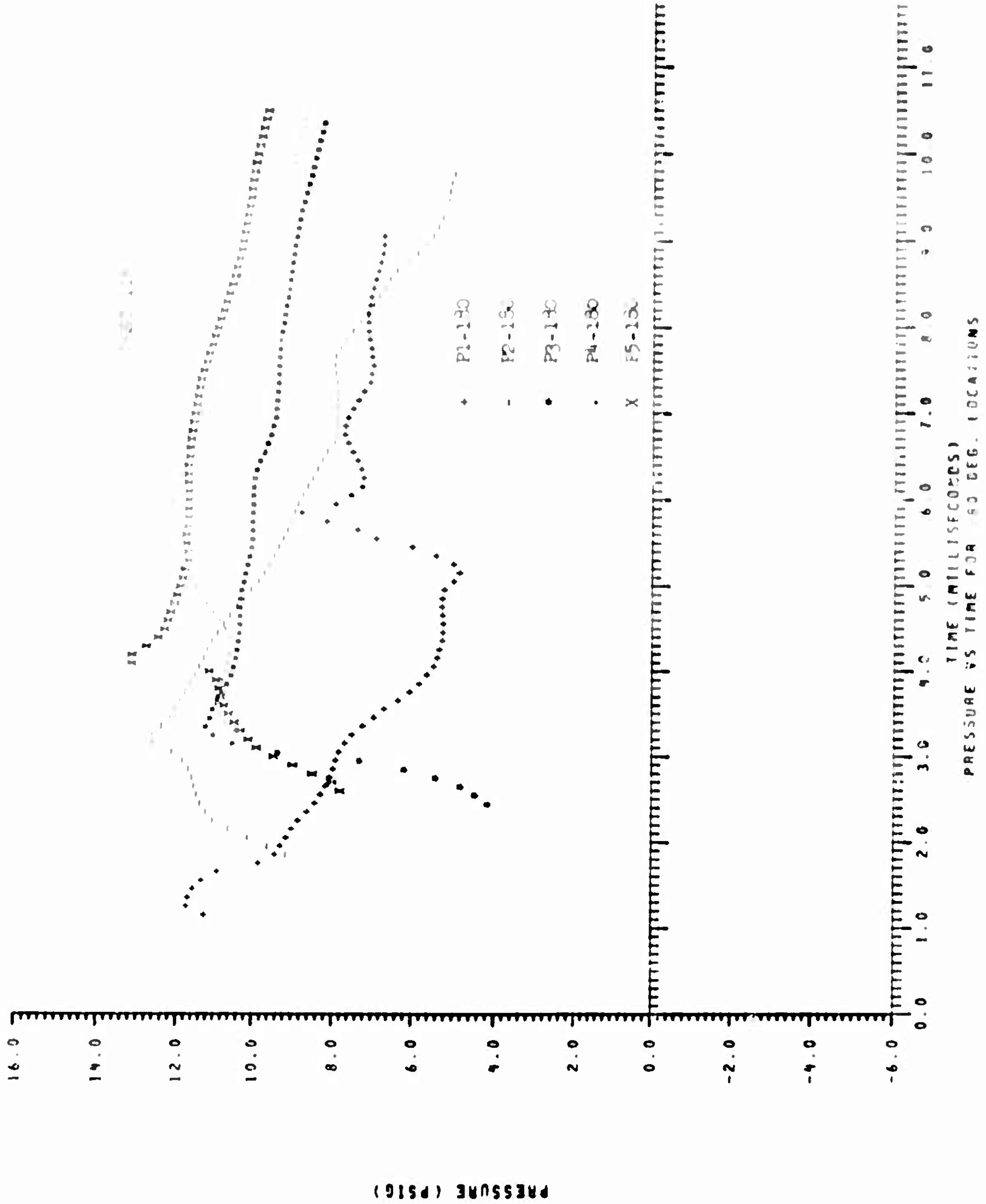

TEST 115
P1-90
P2-90
P4-90
P5-90
PRESSURE (PSIG)
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 90 DEG. LOCATIONS

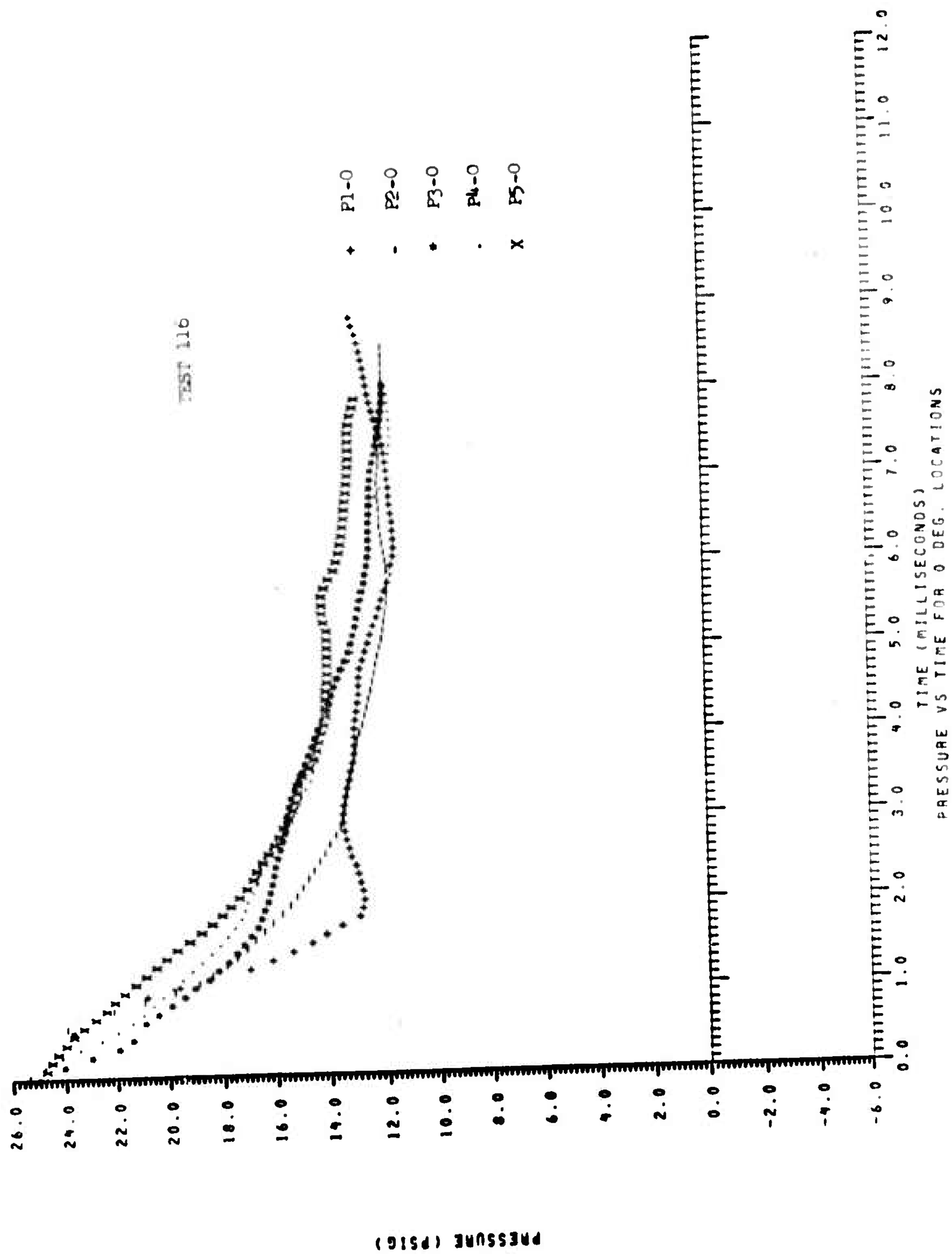


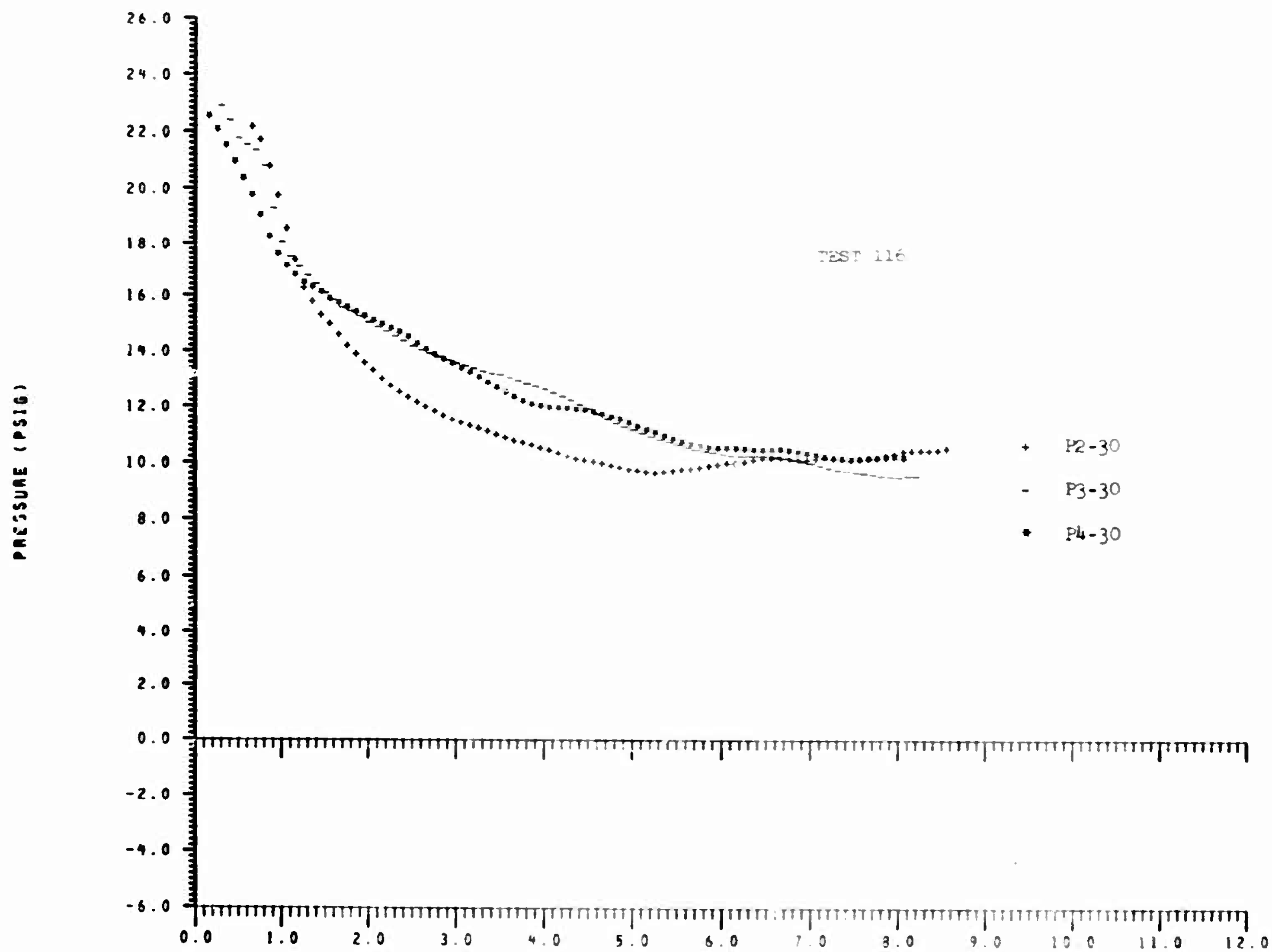
PRESSURE VS TIME FOR 120 DEG LOCATIONS



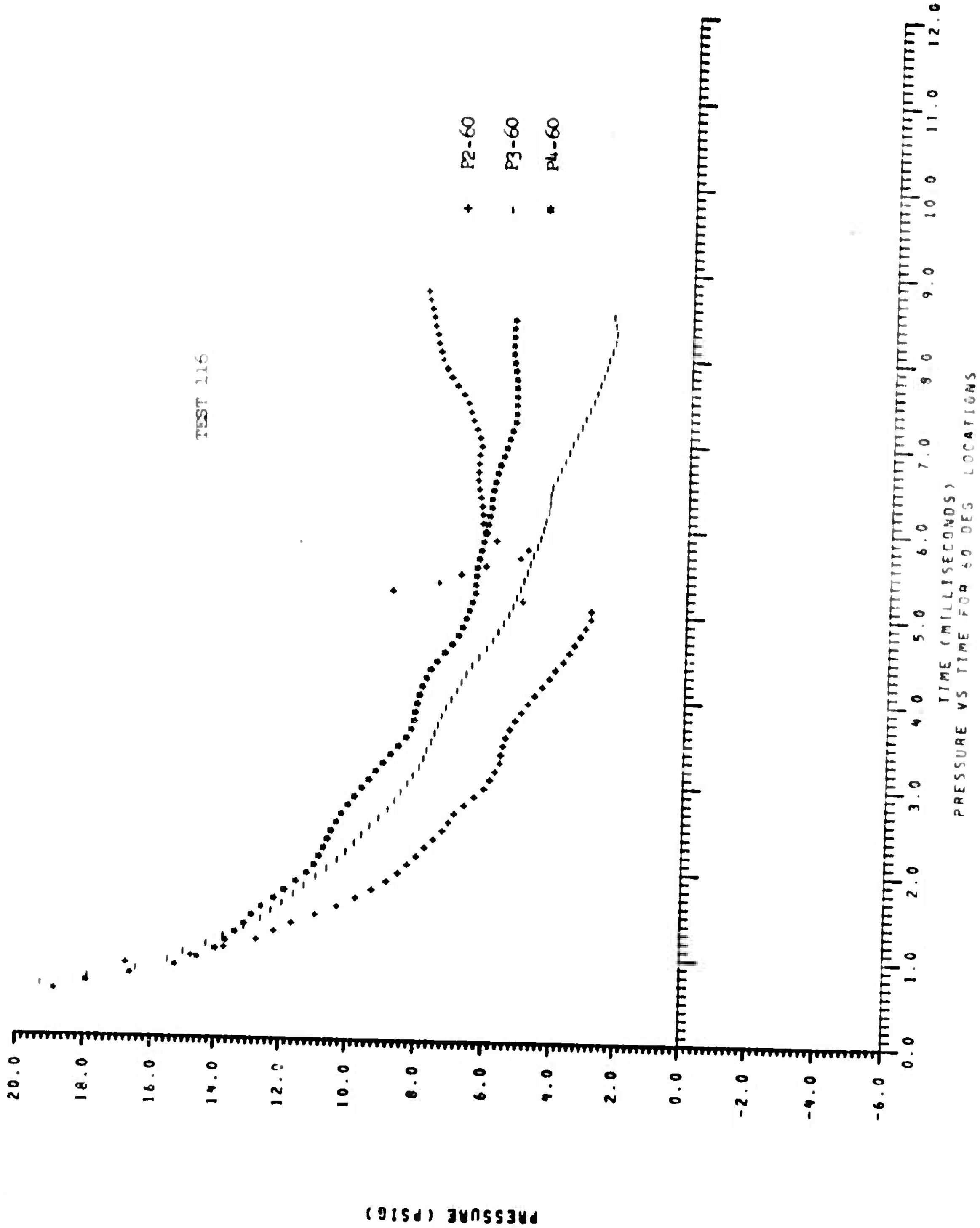
TEST 115
P2-150
P3-150
P4-150
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 150 DEG. LOCATIONS
PRESSURE (PSIG)

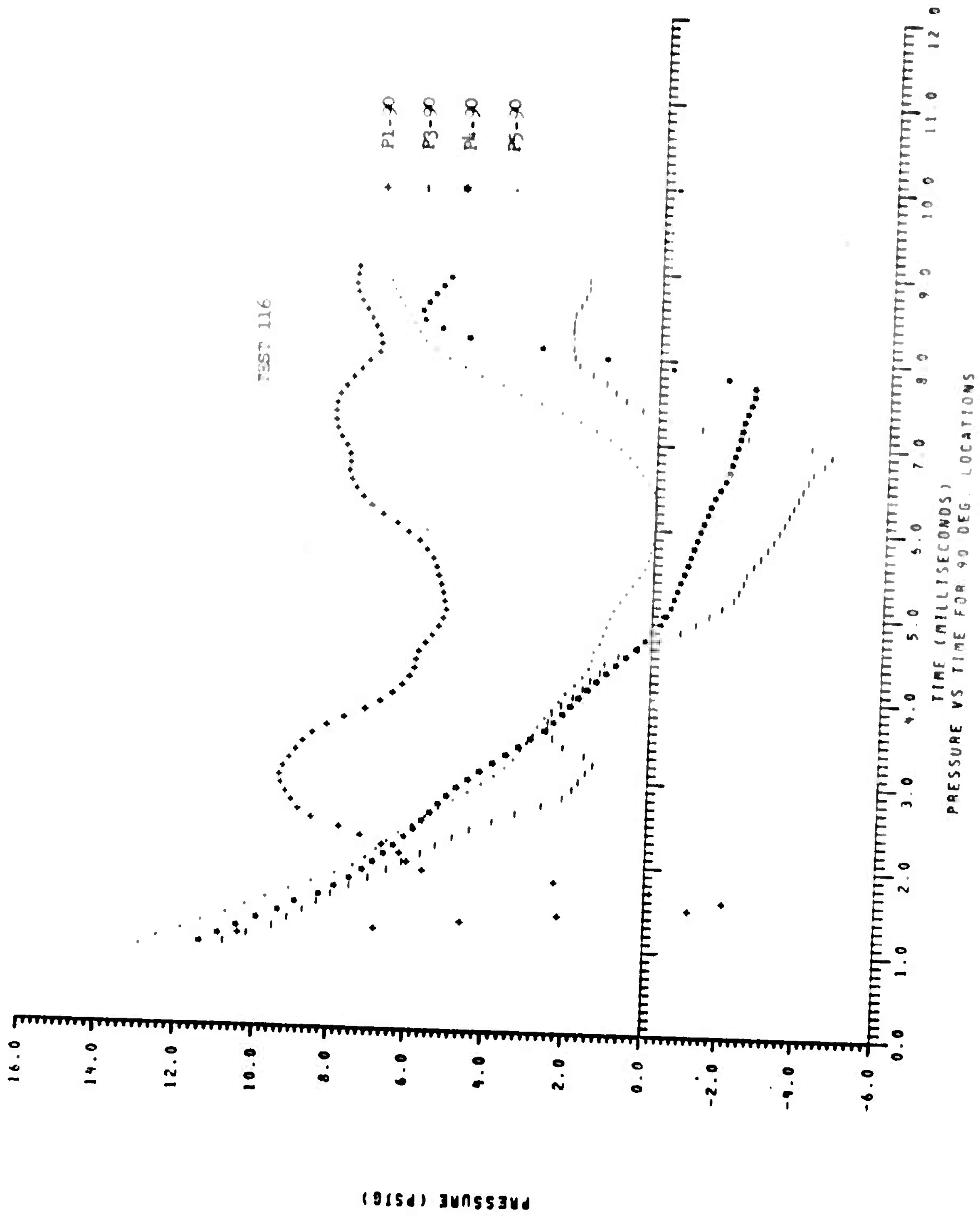

PRESSURE (PSIG)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.0
1.0
2.0
3.0
5.0
6.0
7.0
8.0
10.0
TIME (MILLISECONDS)

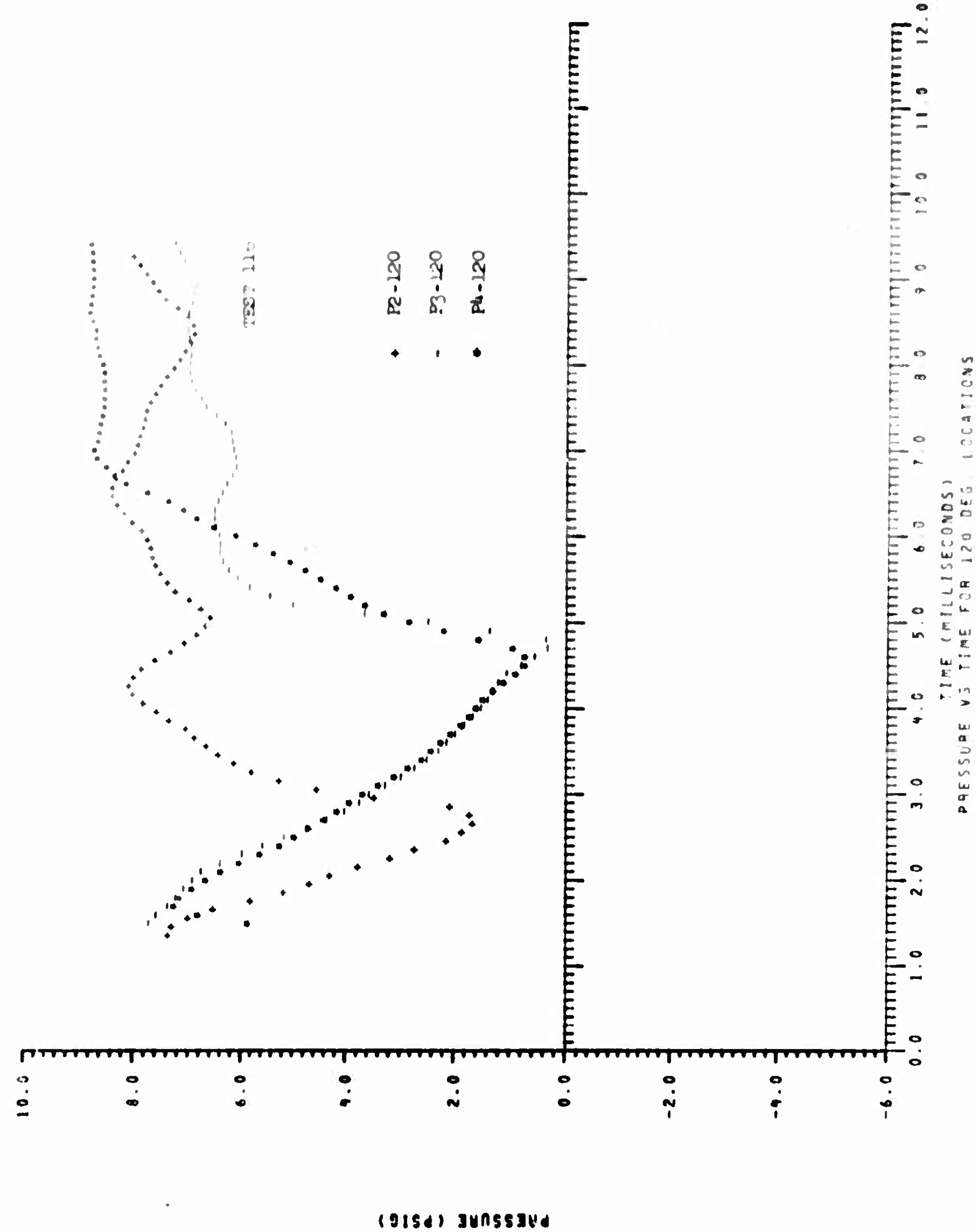

TEST 116
PRESSURE (PSIG)
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 0 DEG. LOCATIONS
+ P1-0
- P2-0
* P3-0
. P4-0
X P5-0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0



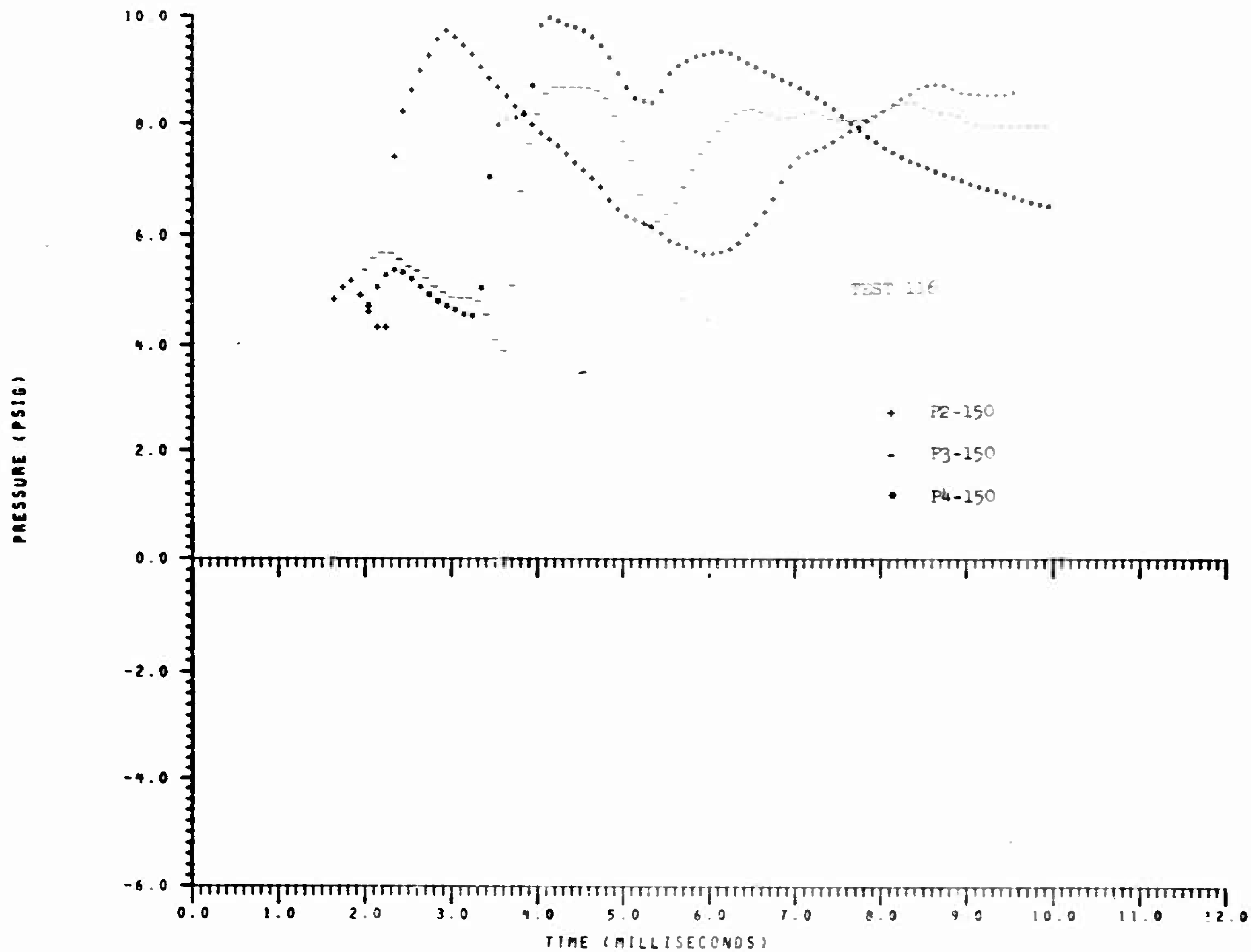
PRESSURE VS TIME FOR 30 DEG. LOCATIONS


TEST 116
P2-60
P3-60
P4-60
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 60 DEG LOCATIONS
PRESSURE (PSIG)

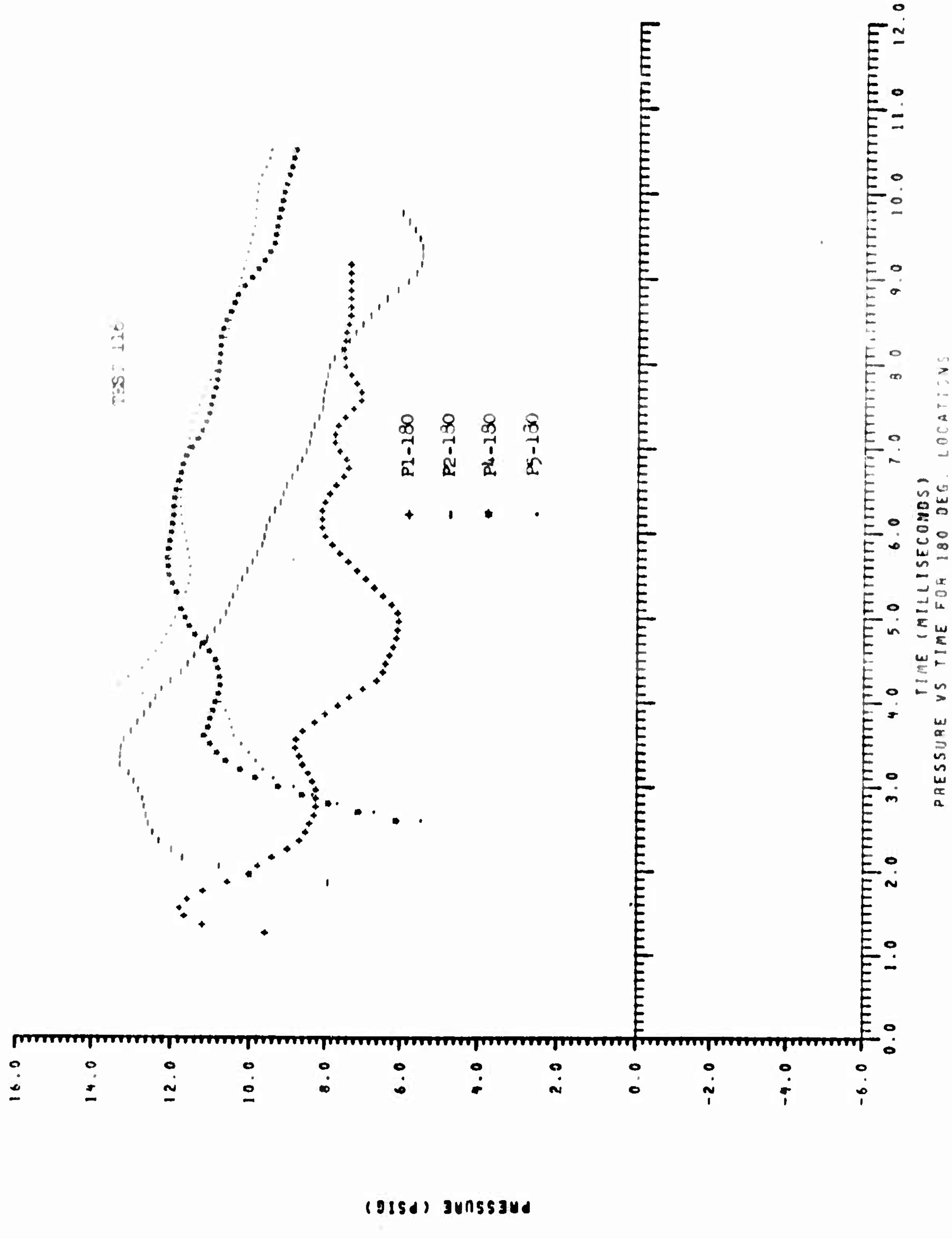

TEST 116
P1-90
P3-90
P4-90
P5-90
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSIG)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 90 DEG. LOCATIONS

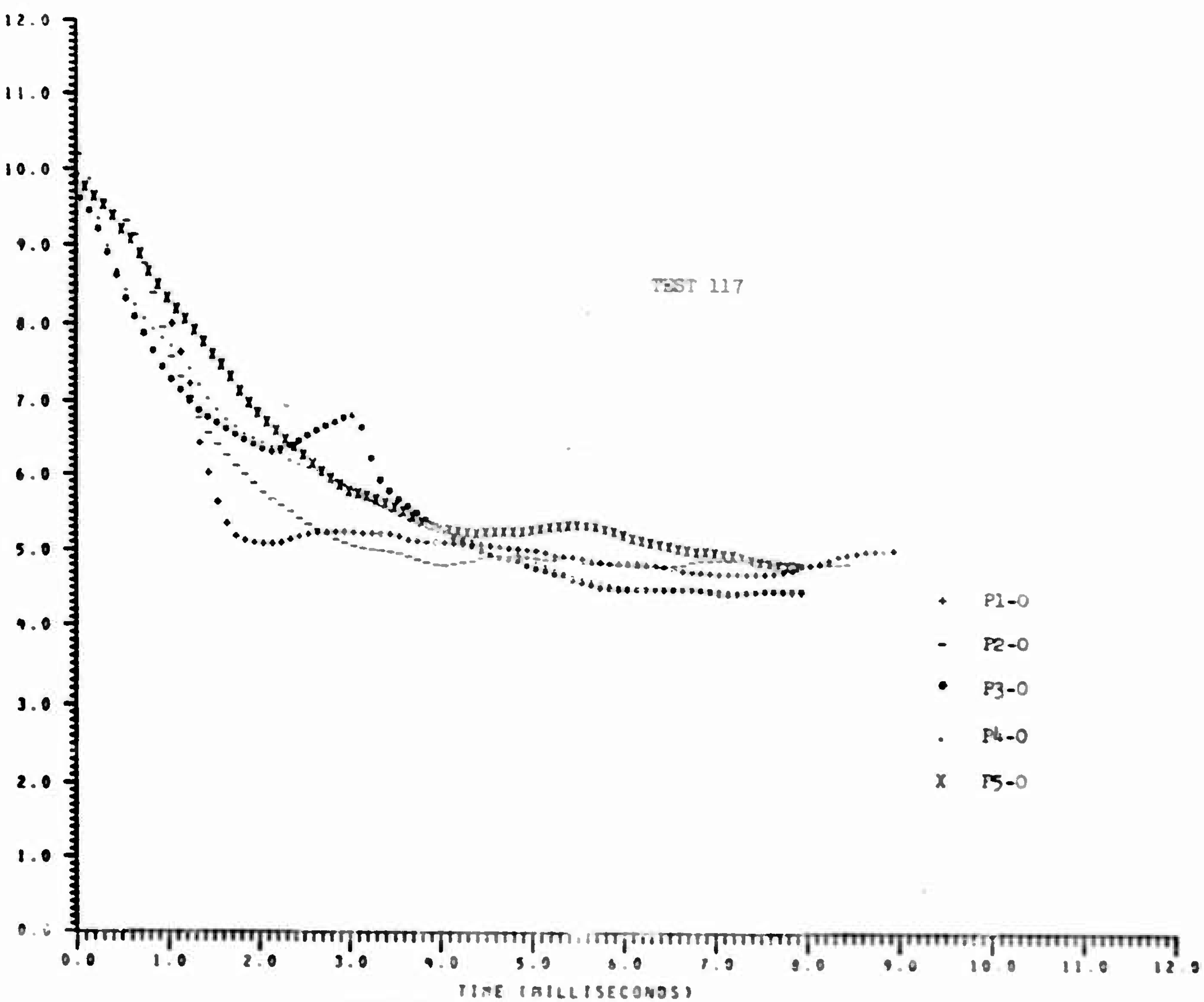


TEST 11b
P2-120
P3-120
P4-120
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 120 DEG. LOCATIONS
PRESSURE (PSIG)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0

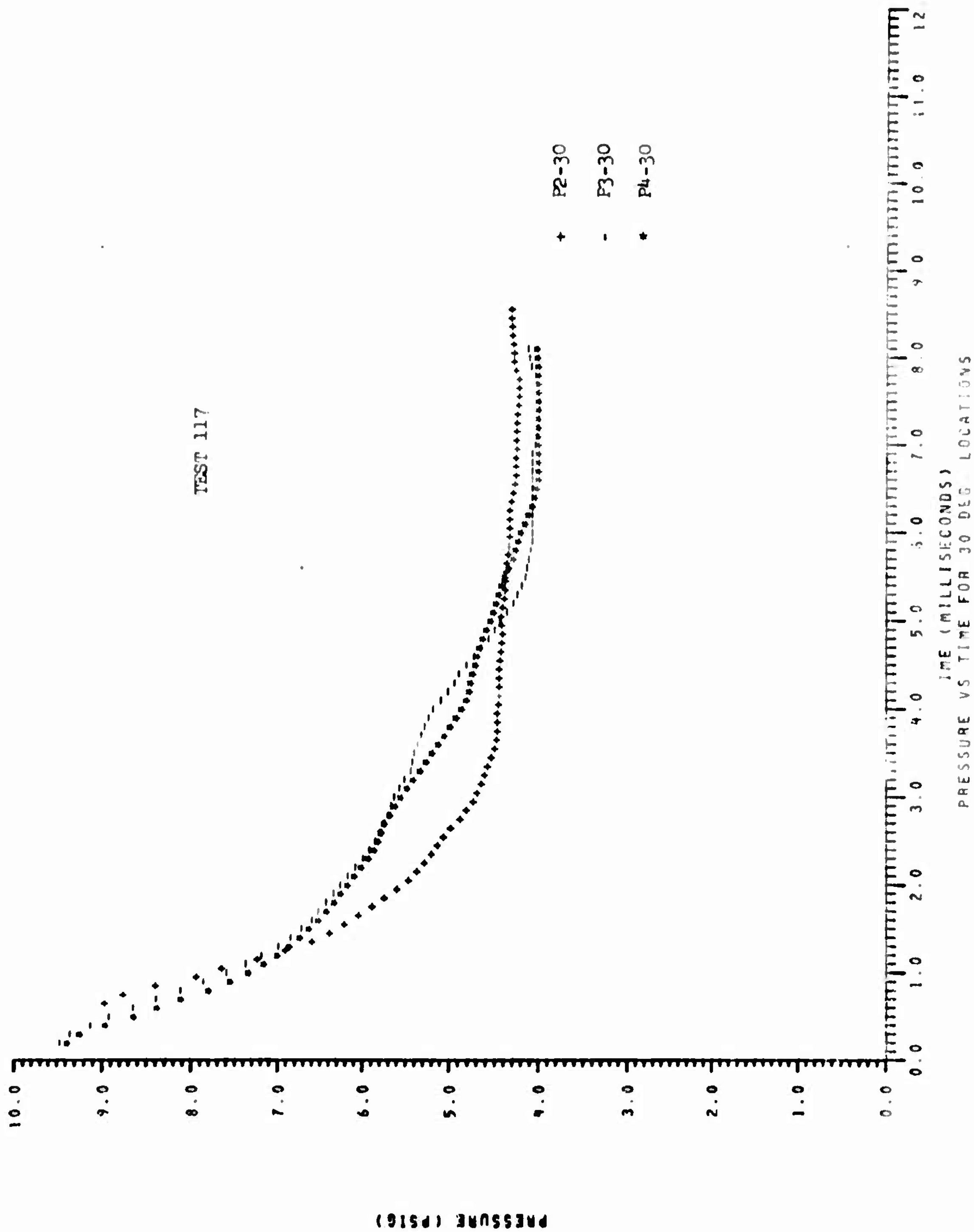


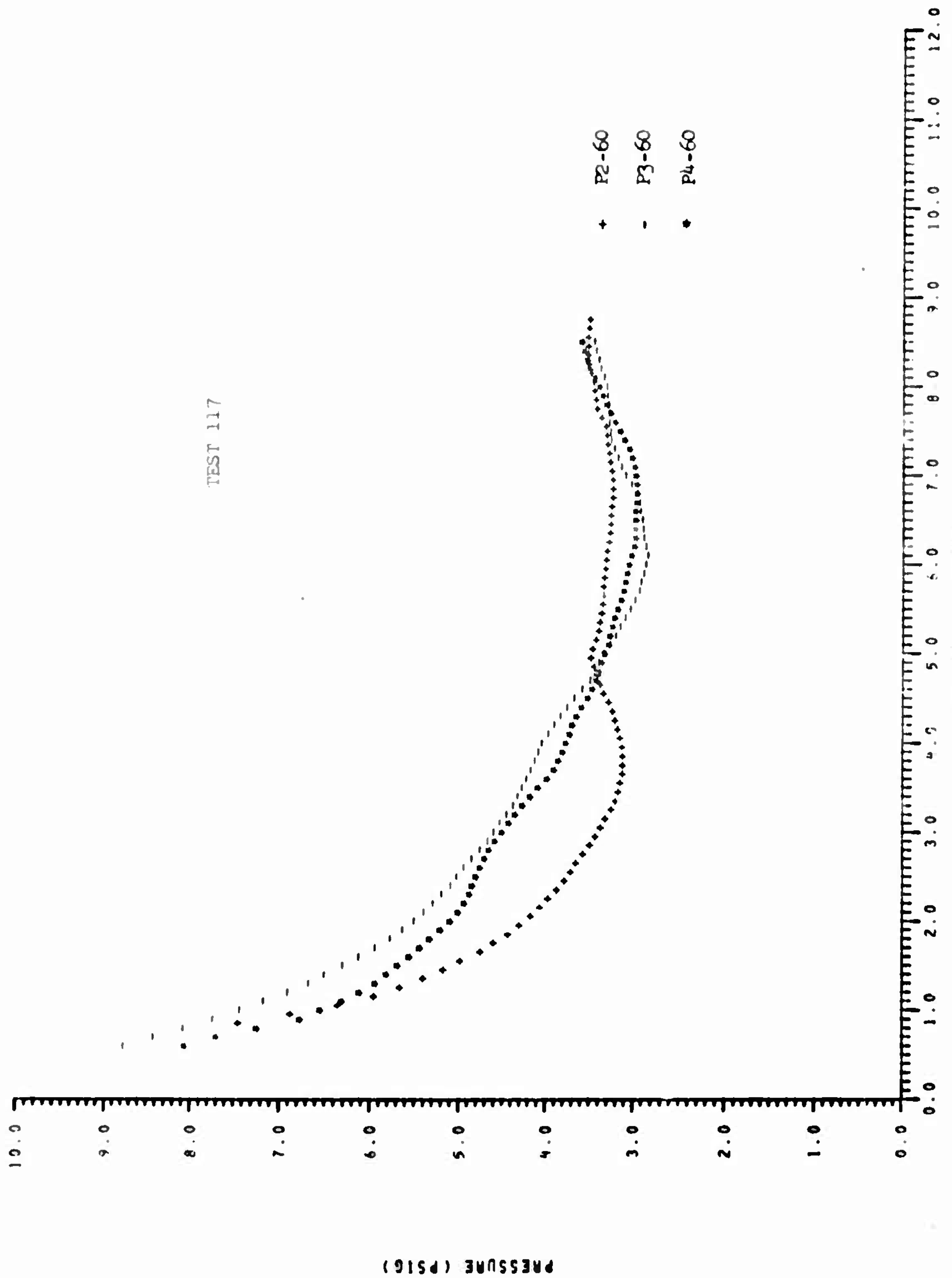
PRESSURE VS TIME FOR 150 DEG. LOCATIONS


TEST 116
P1-180
P2-180
P4-180
P5-180
PRESSURE (PSIG)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 180 DEG. LOCATIONS

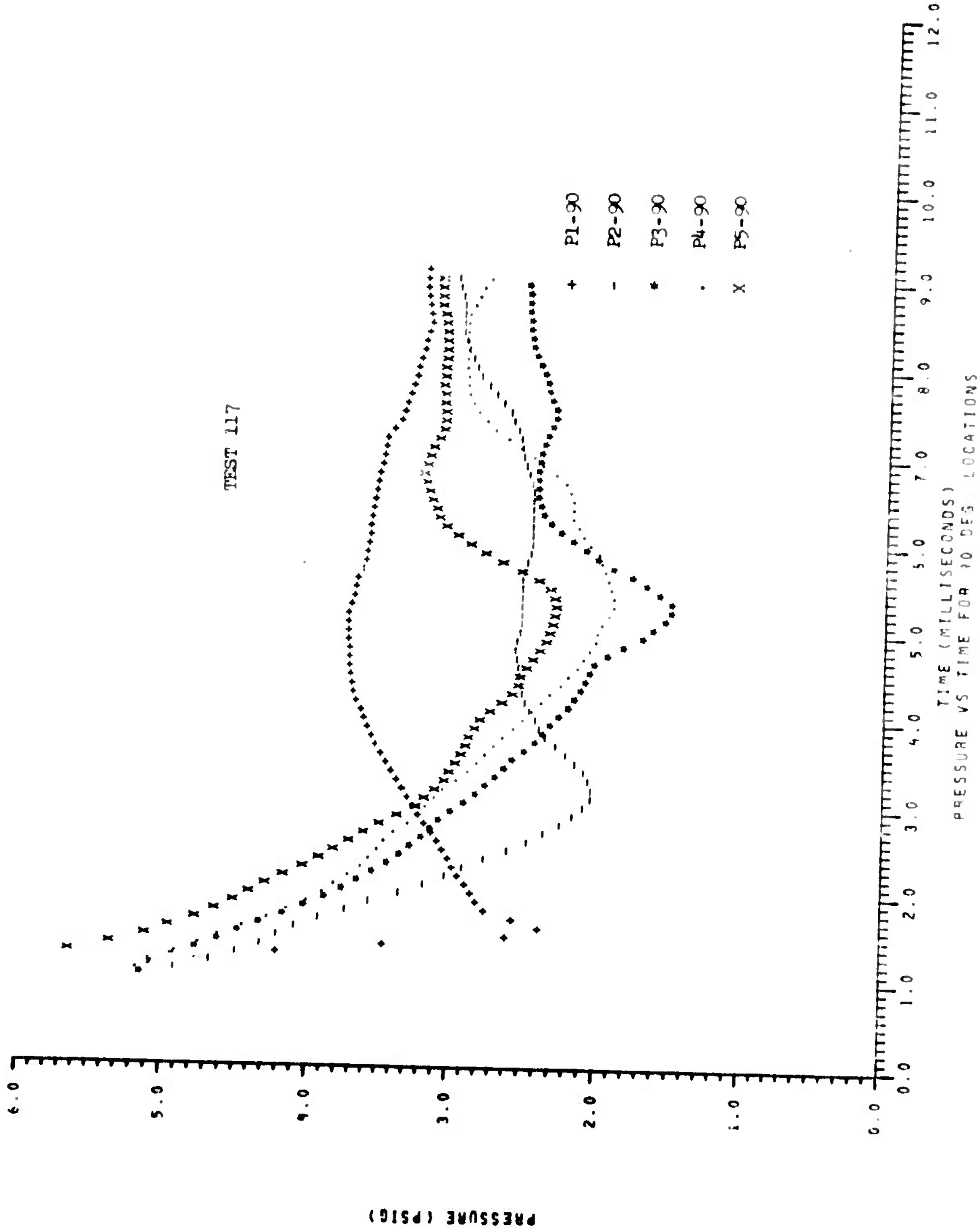


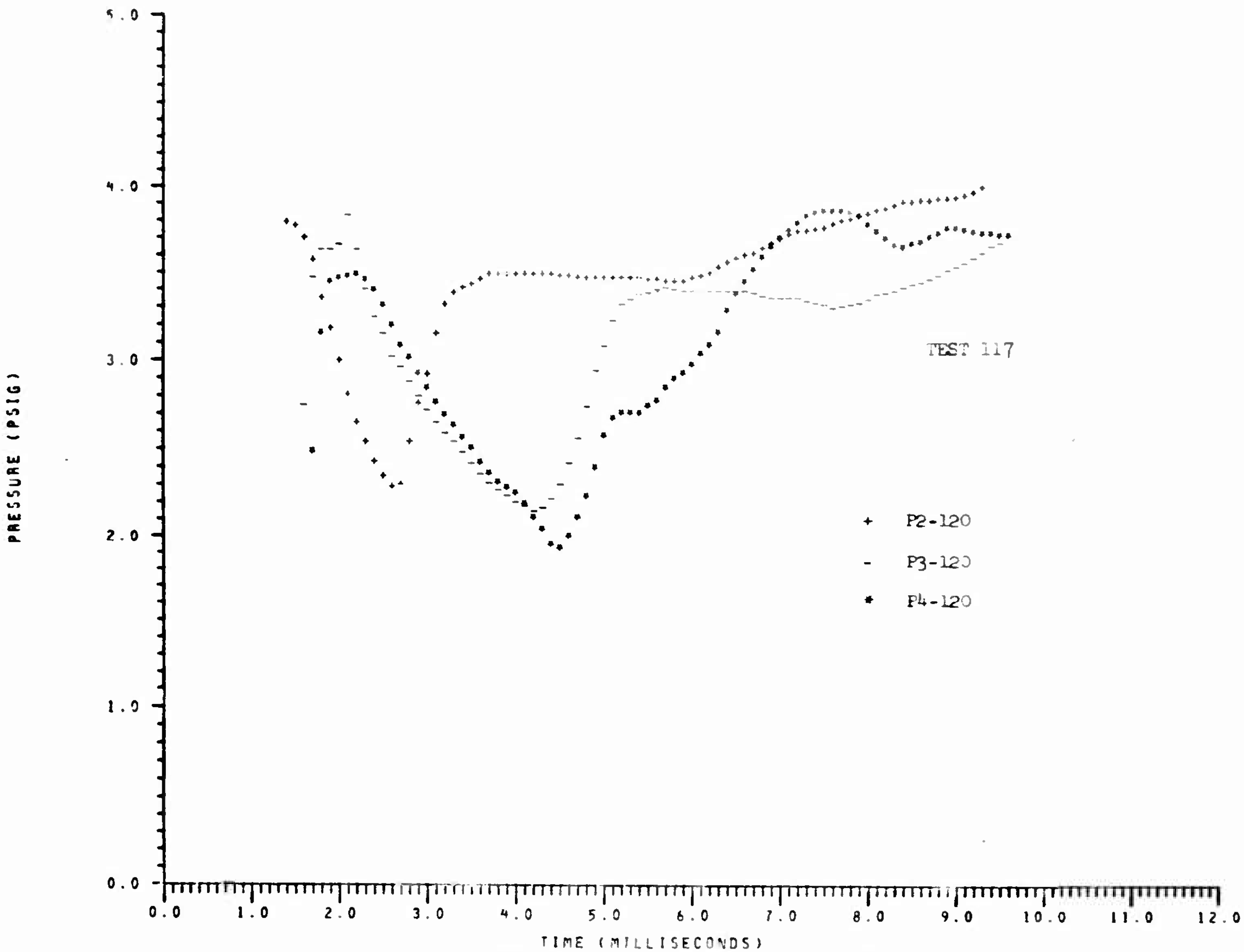
PRESSURE VS TIME FOR 0 DEG. LOCATIONS


TEST 117
P2-30
P3-30
P4-30
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 30 DEG LOCATIONS
PRESSURE (PSIG)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0

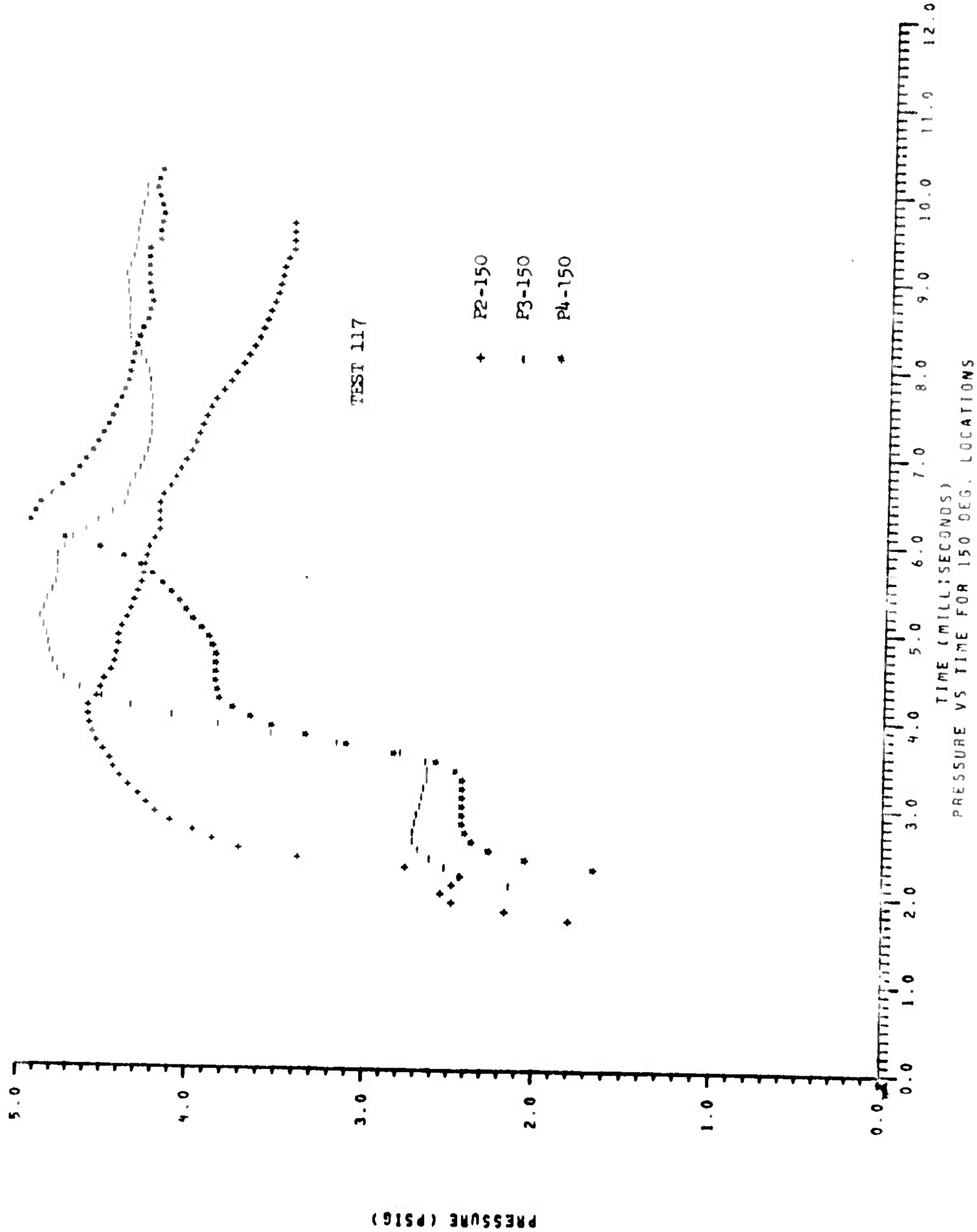


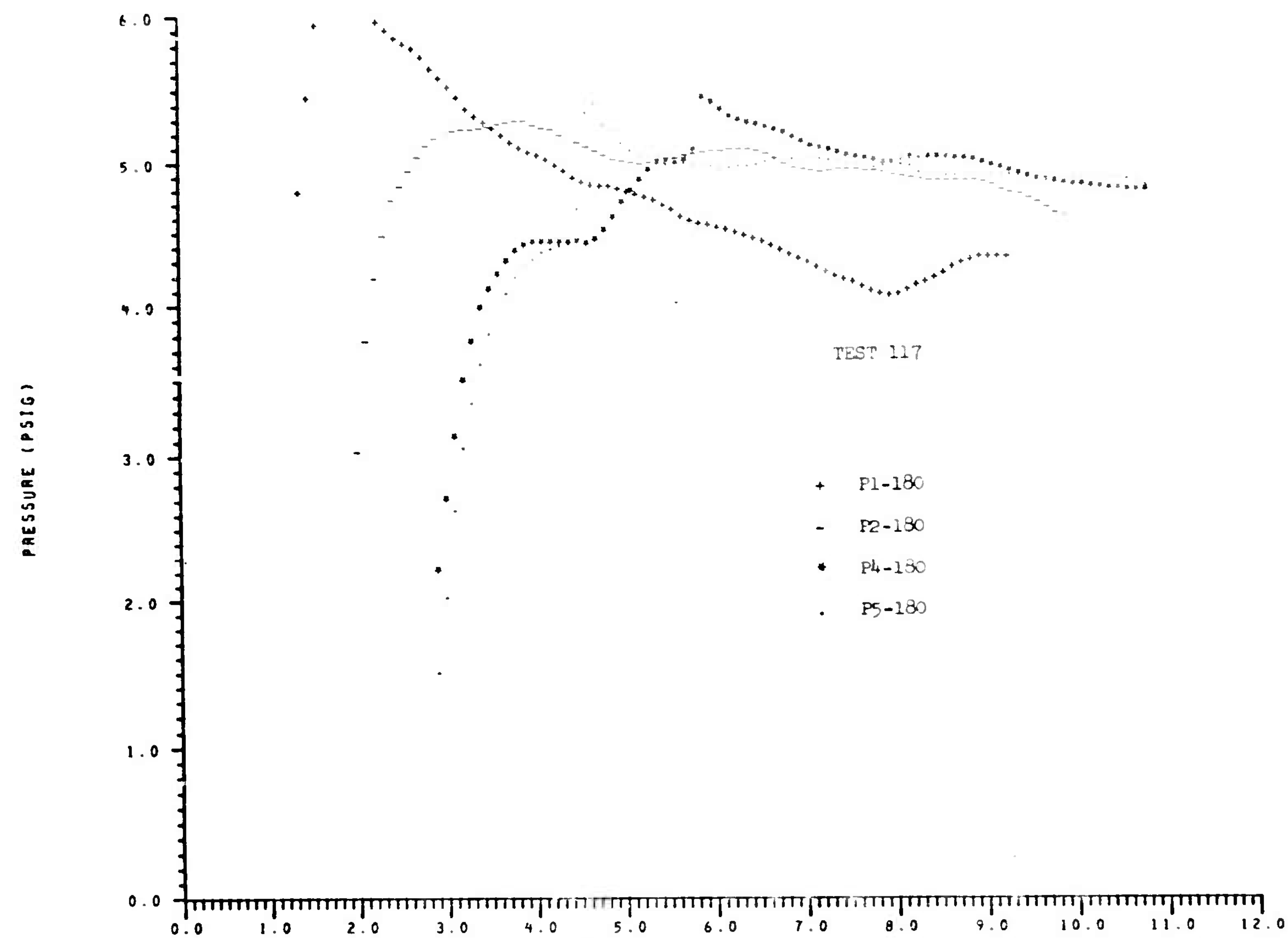
PRESSURE VS TIME FOR 60 DEG LOCATIONS


TEST 117
+ P1-90
- P2-90
* P3-90
. P4-90
X P5-90
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 90 DEG LOCATIONS
PRESSURE (PSIG)

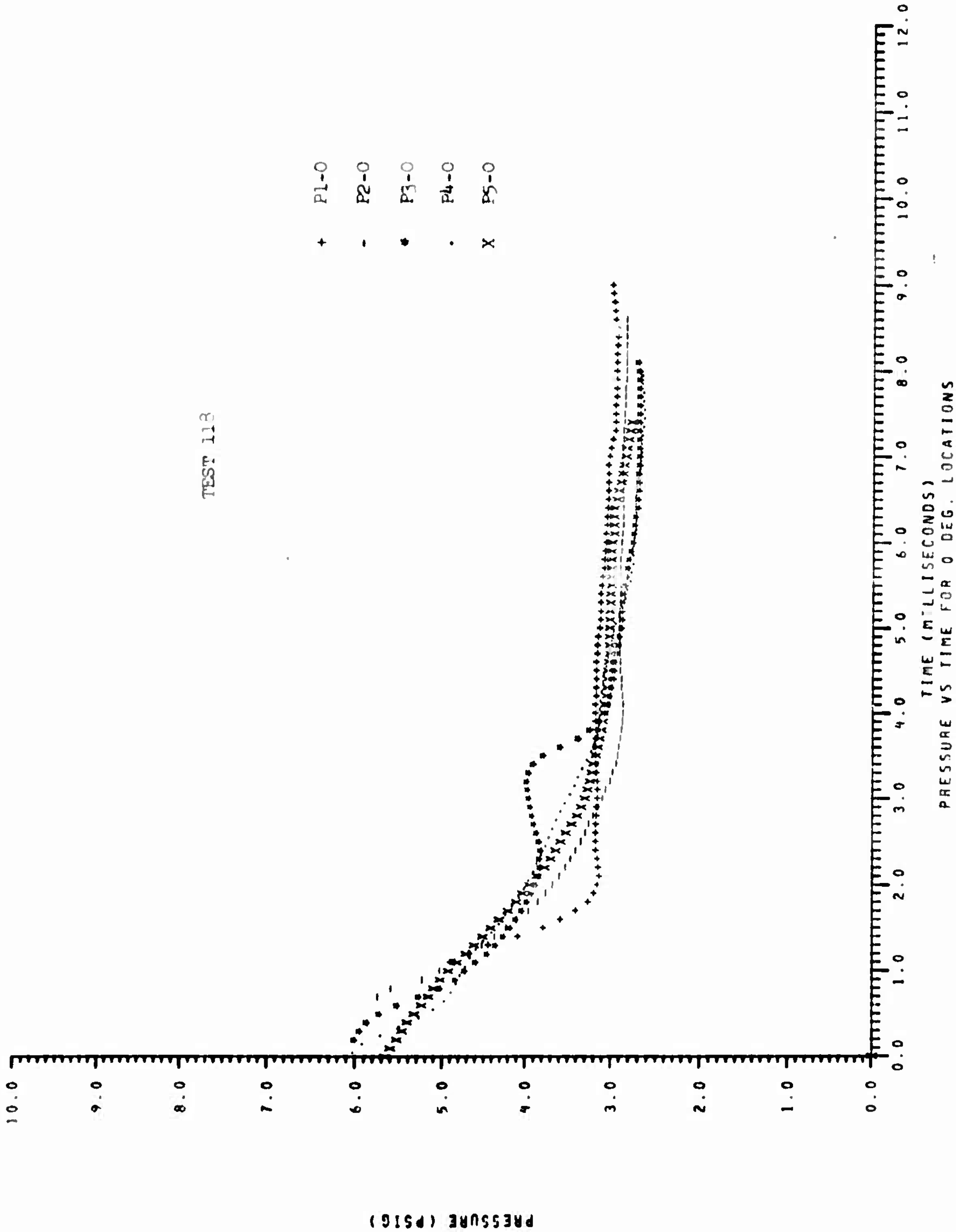


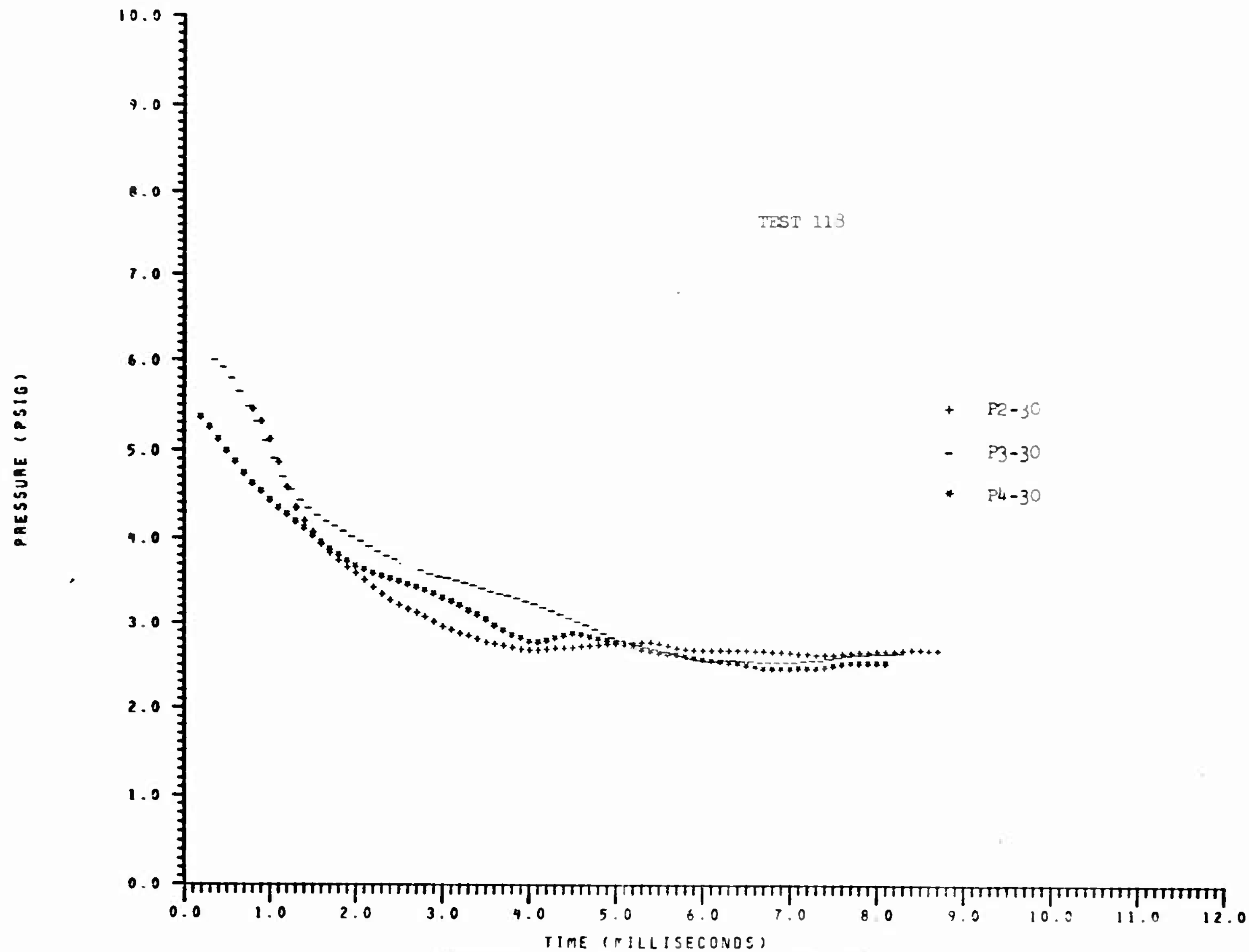
PRESSURE VS TIME FOR 120 DEG. LOCATIONS


TEST 117
+ P2-150
- P3-150
* P4-150
PRESSURE (PSIG)
0.0
1.0
2.0
3.0
4.0
5.0
TIME (MILLISECONDS)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
PRESSURE VS TIME FOR 150 DEG. LOCATIONS

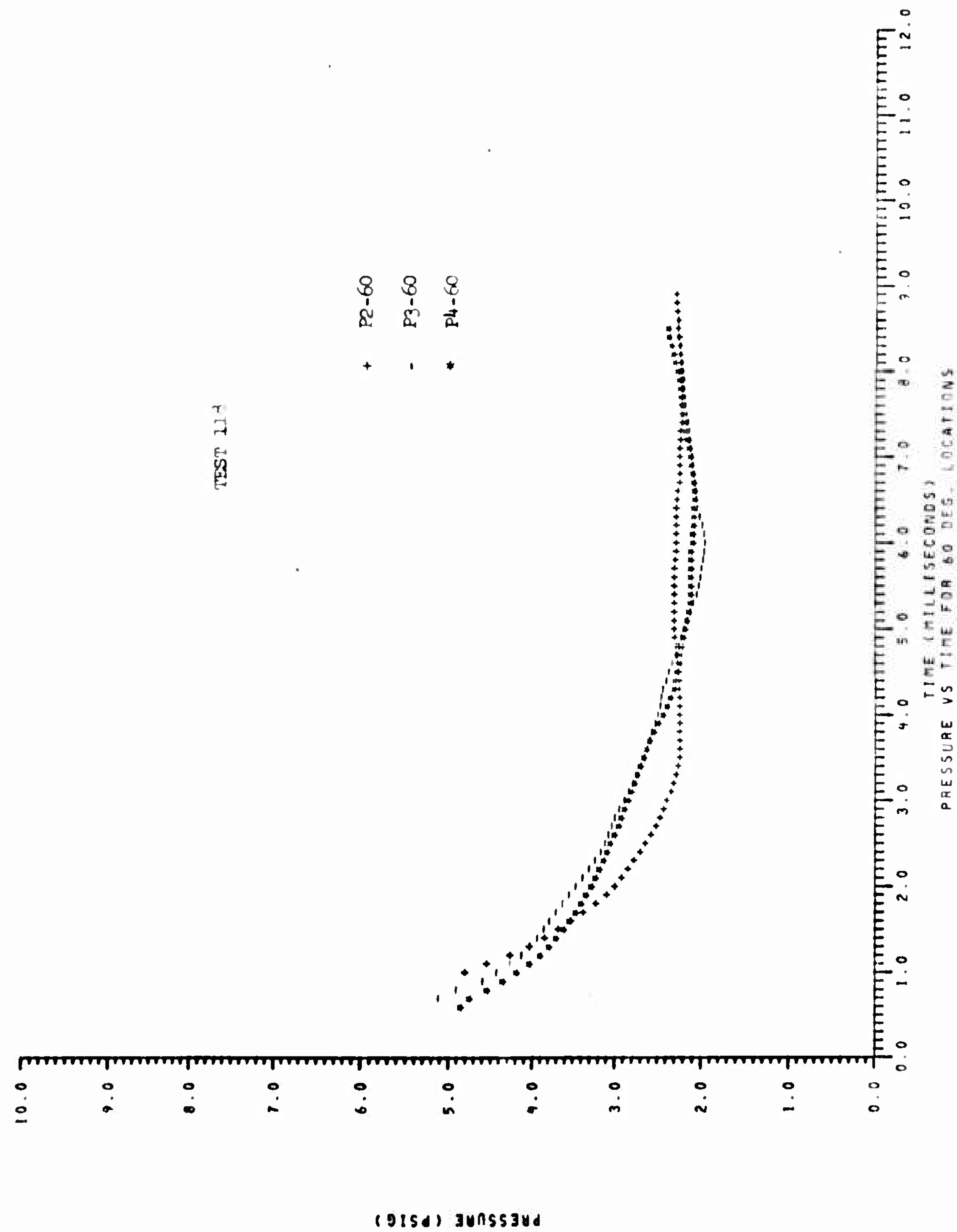


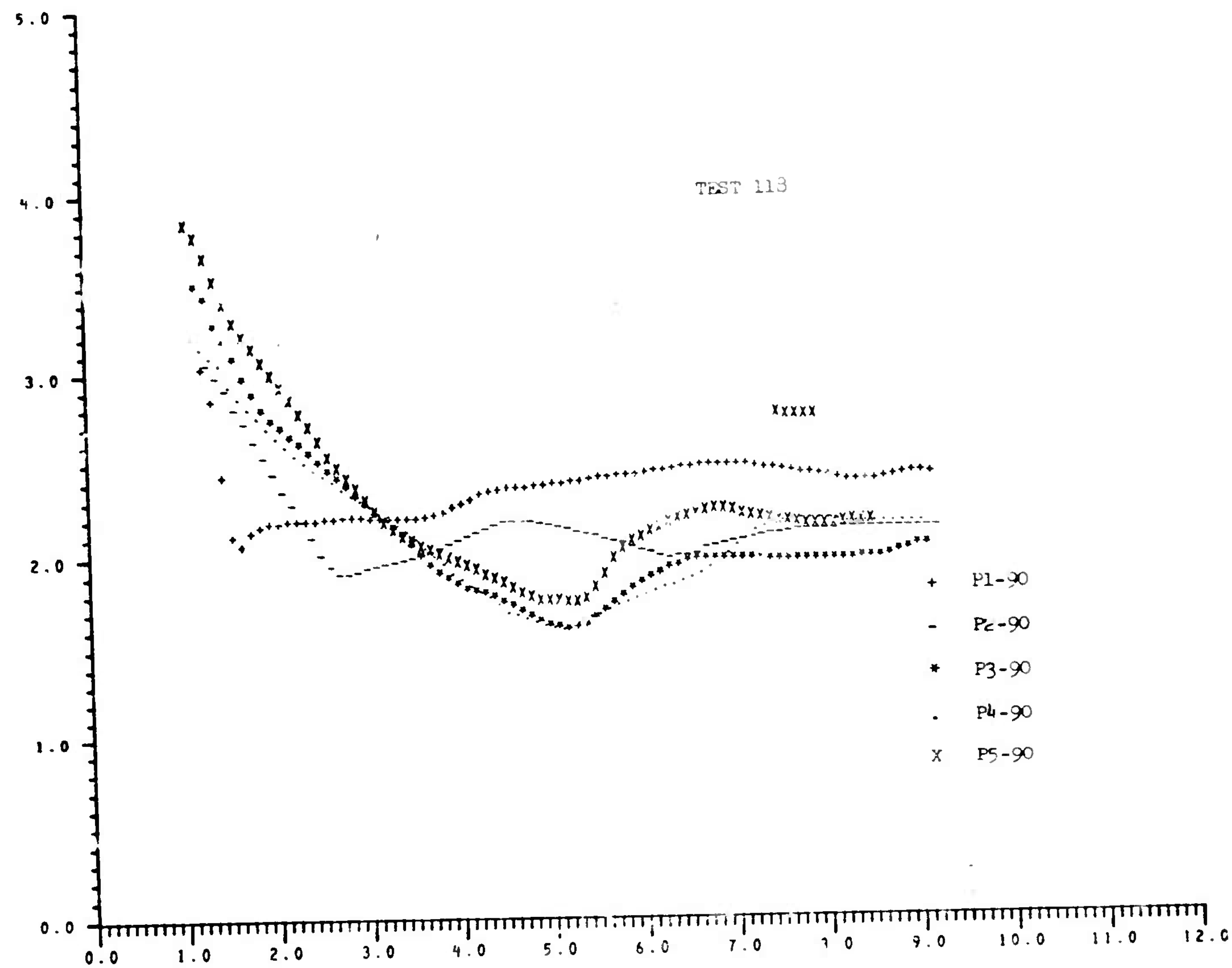
PRESSURE VS TIME FOR 180 DEG. LOCATIONS


TEST 113
P1-0
P2-0
P3-0
P4-0
P5-0
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 0 DEG. LOCATIONS
PRESSURE (PSIG)

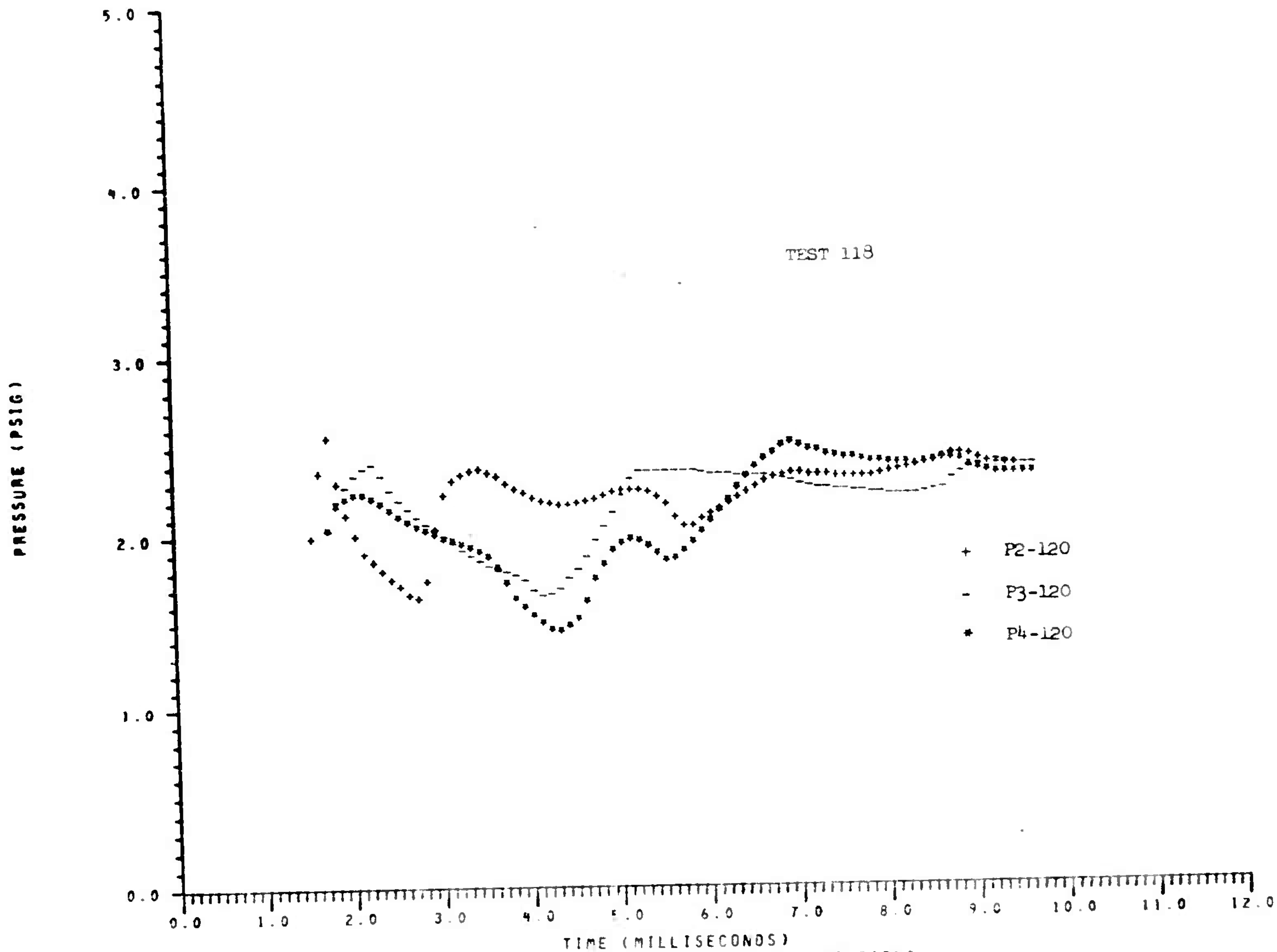


PRESSURE VS TIME FOR 30 DEG. LOCATIONS

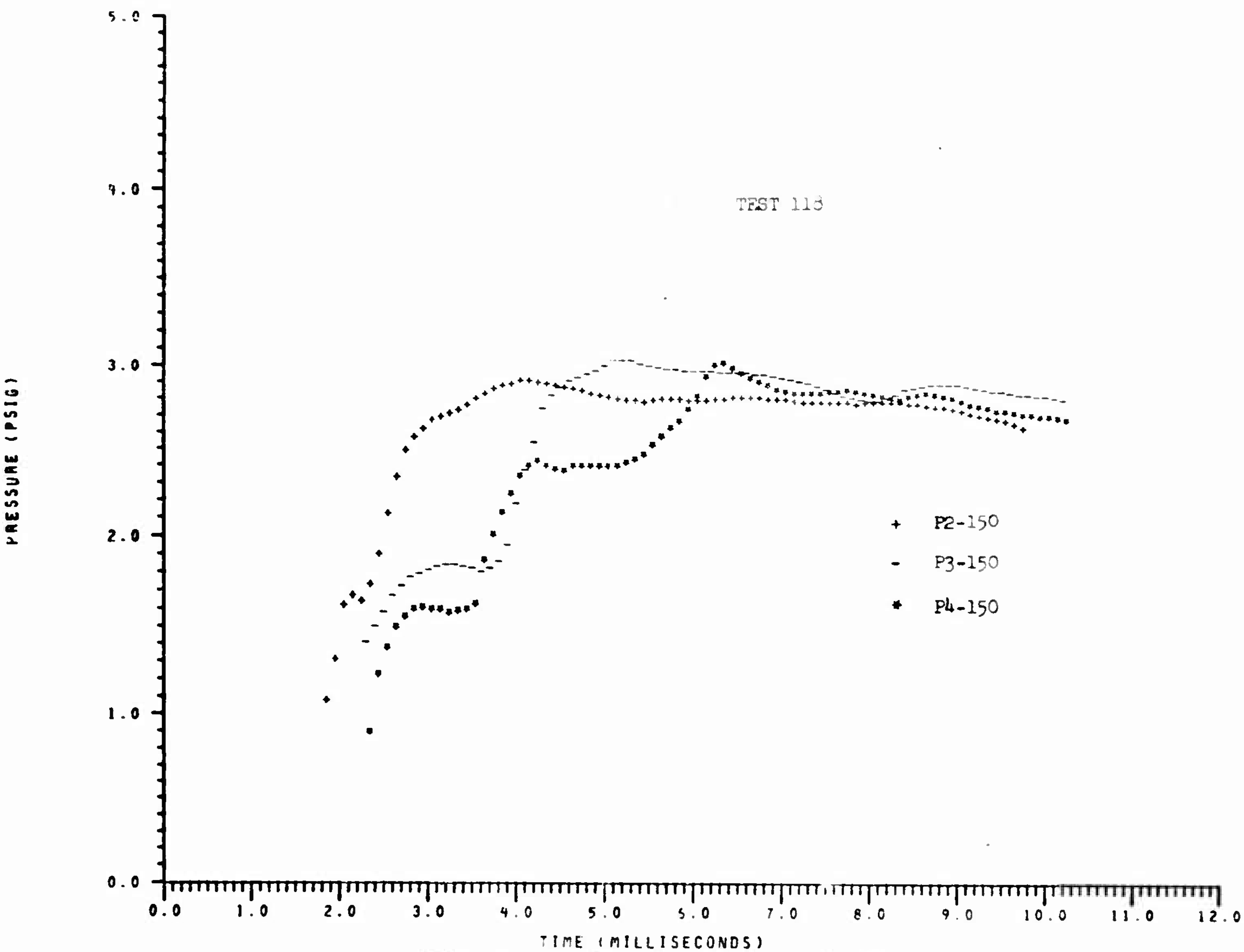

TEST 11
+ P2-60
- P3-60
* P4-60
PRESSURE (PSIG)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME (MILLISECONDS)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
PRESSURE VS TIME FOR 60 DEG. LOCATIONS



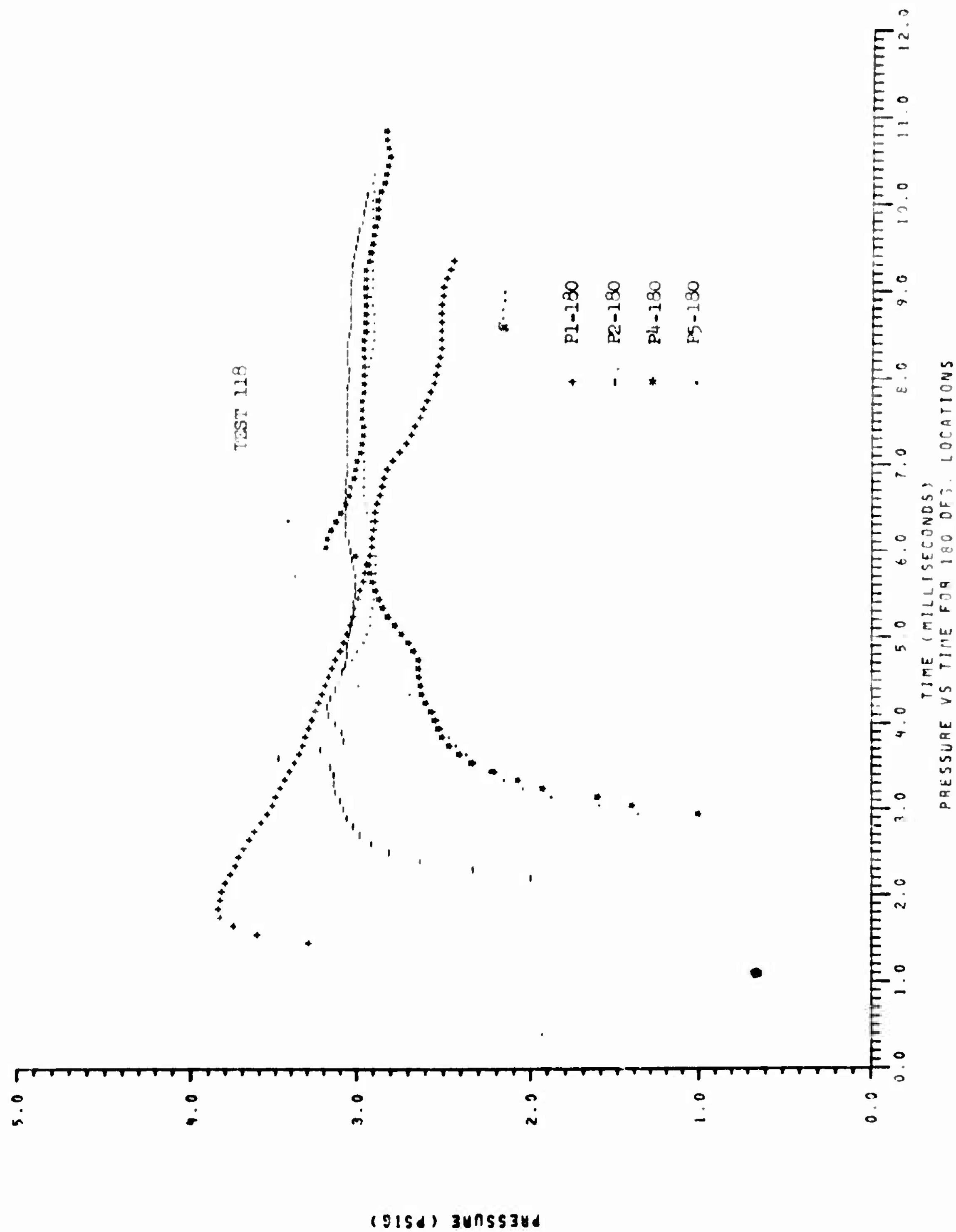
PRESSURE VS TIME FOR 90 DEG. LOCATIONS



PRESSURE VS TIME FOR 120 DEG. LOCATIONS

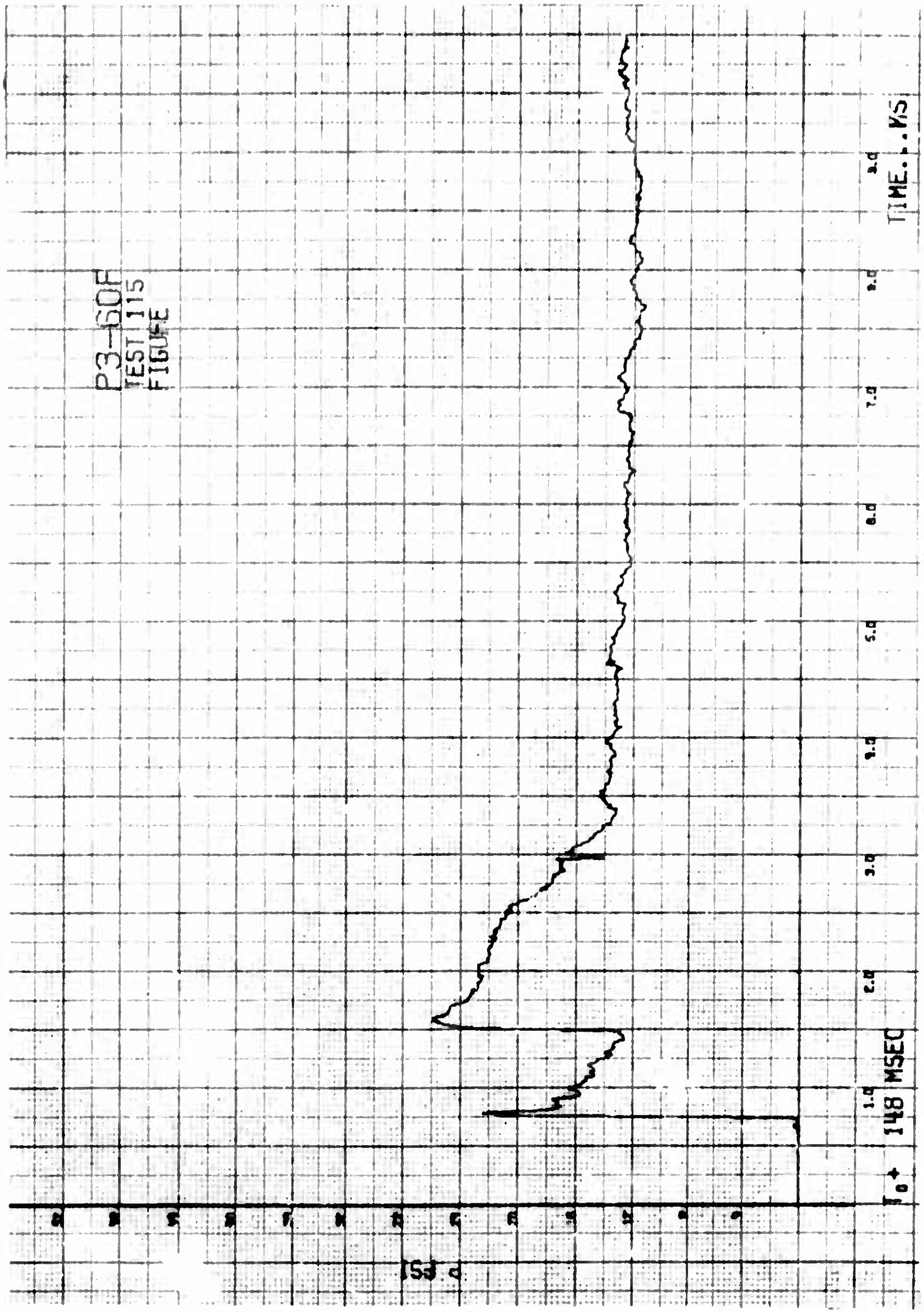


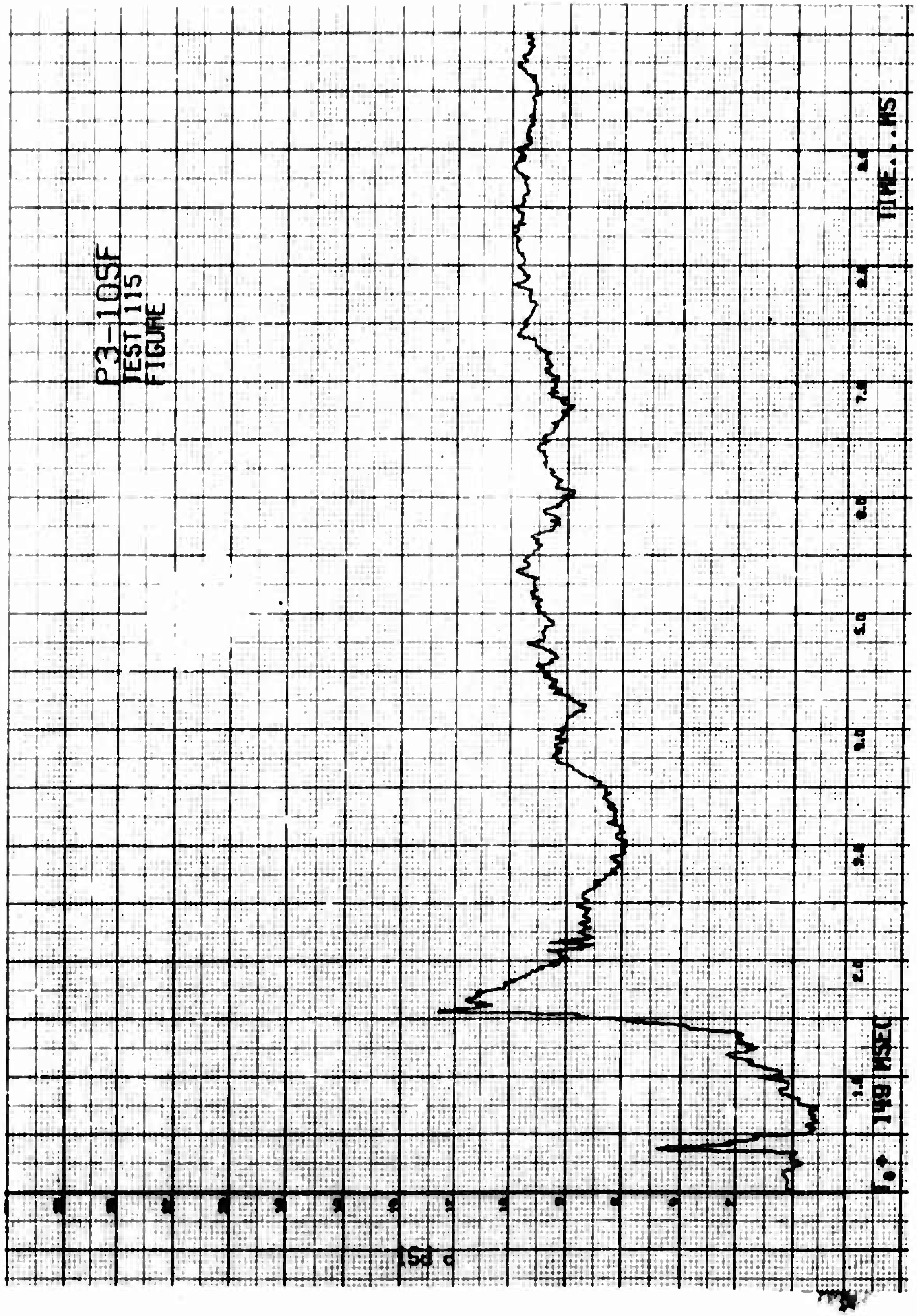
PRESSURE VS TIME FOR 150 DEG. LOCATIONS

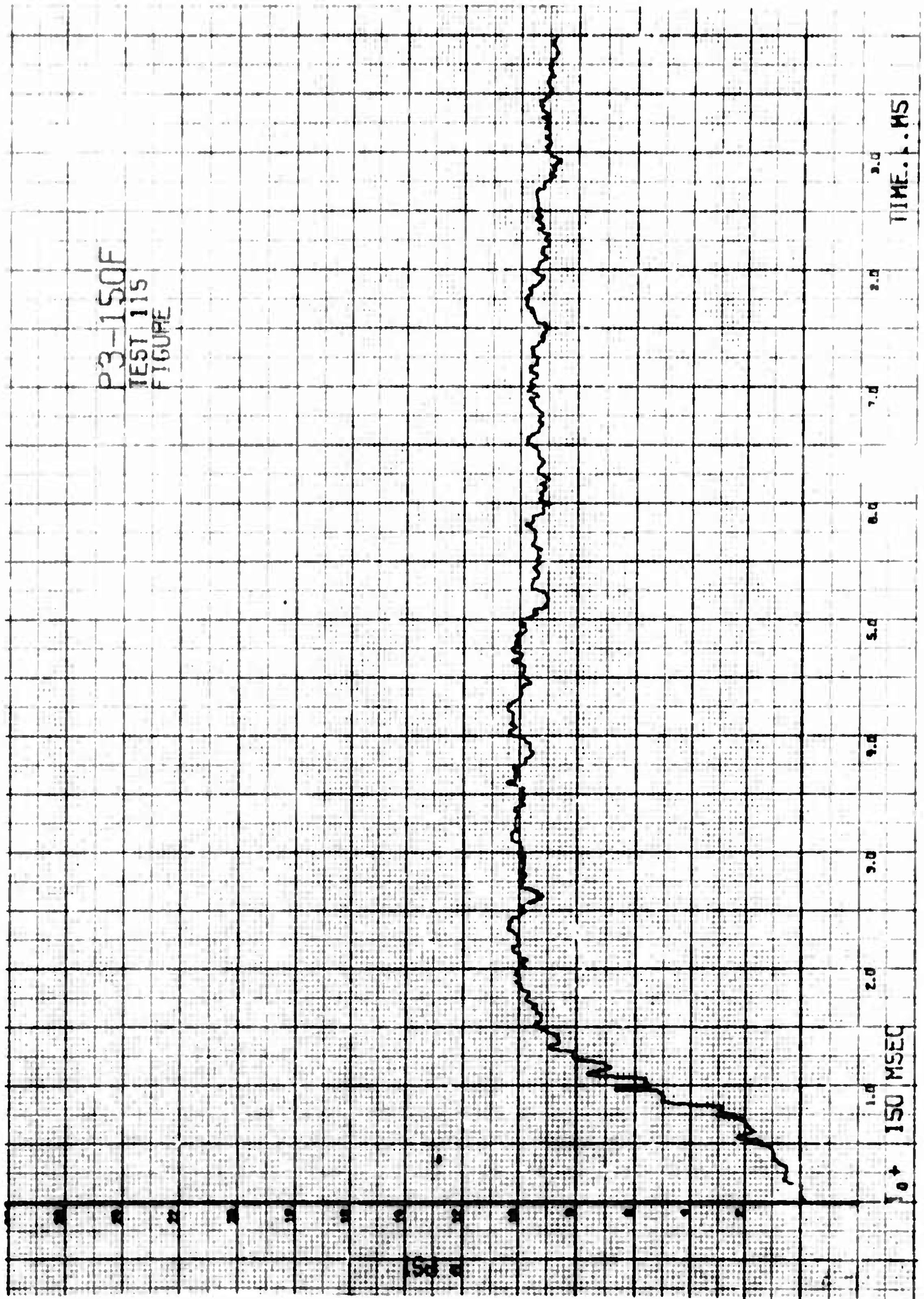

TEST 118
P1-180
P2-180
P4-180
P5-180
TIME (MILLISECONDS)
PRESSURE VS TIME FOR 180 DEG. LOCATIONS
PRESSURE (PSIG)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0

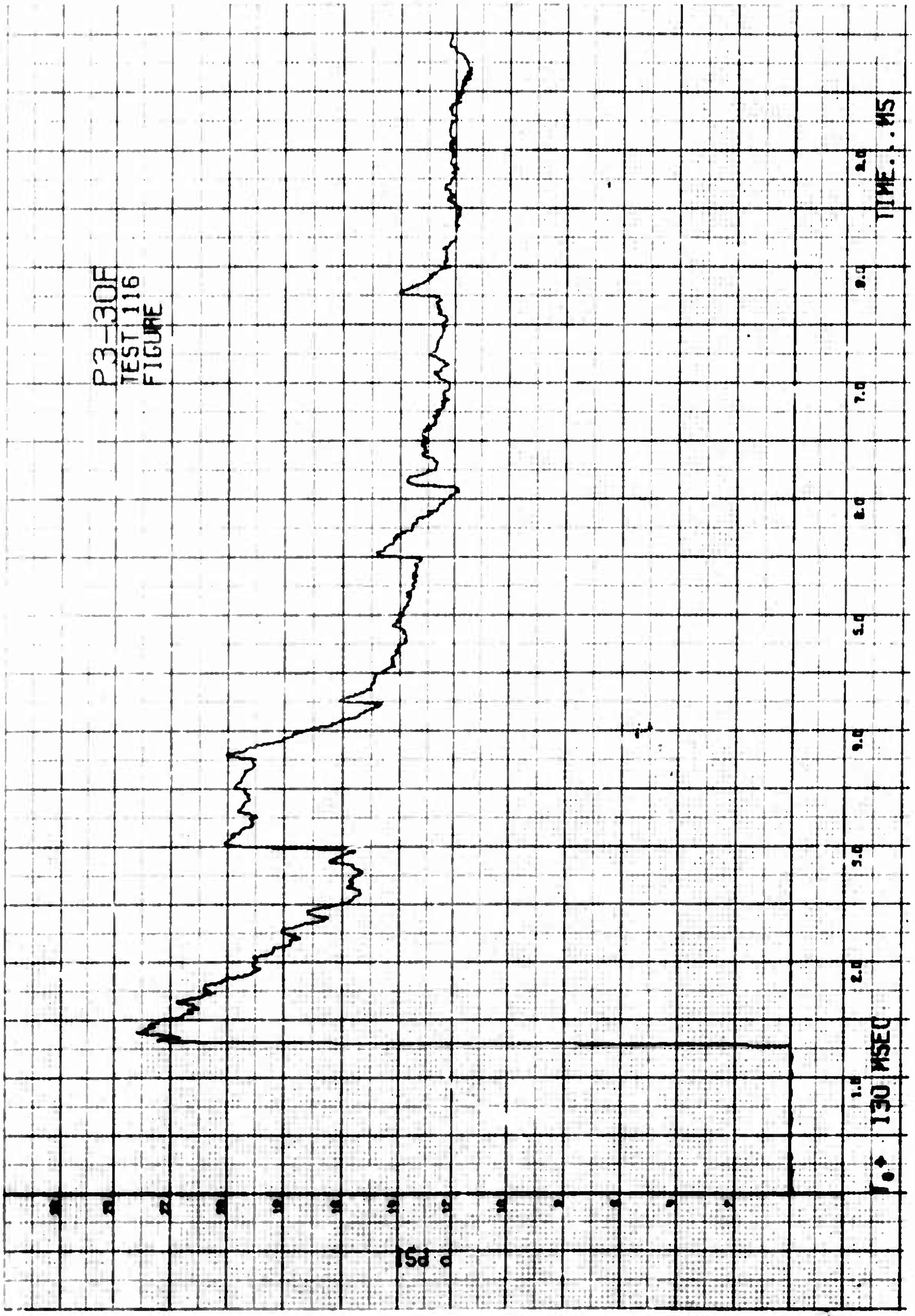
APPENDIX B

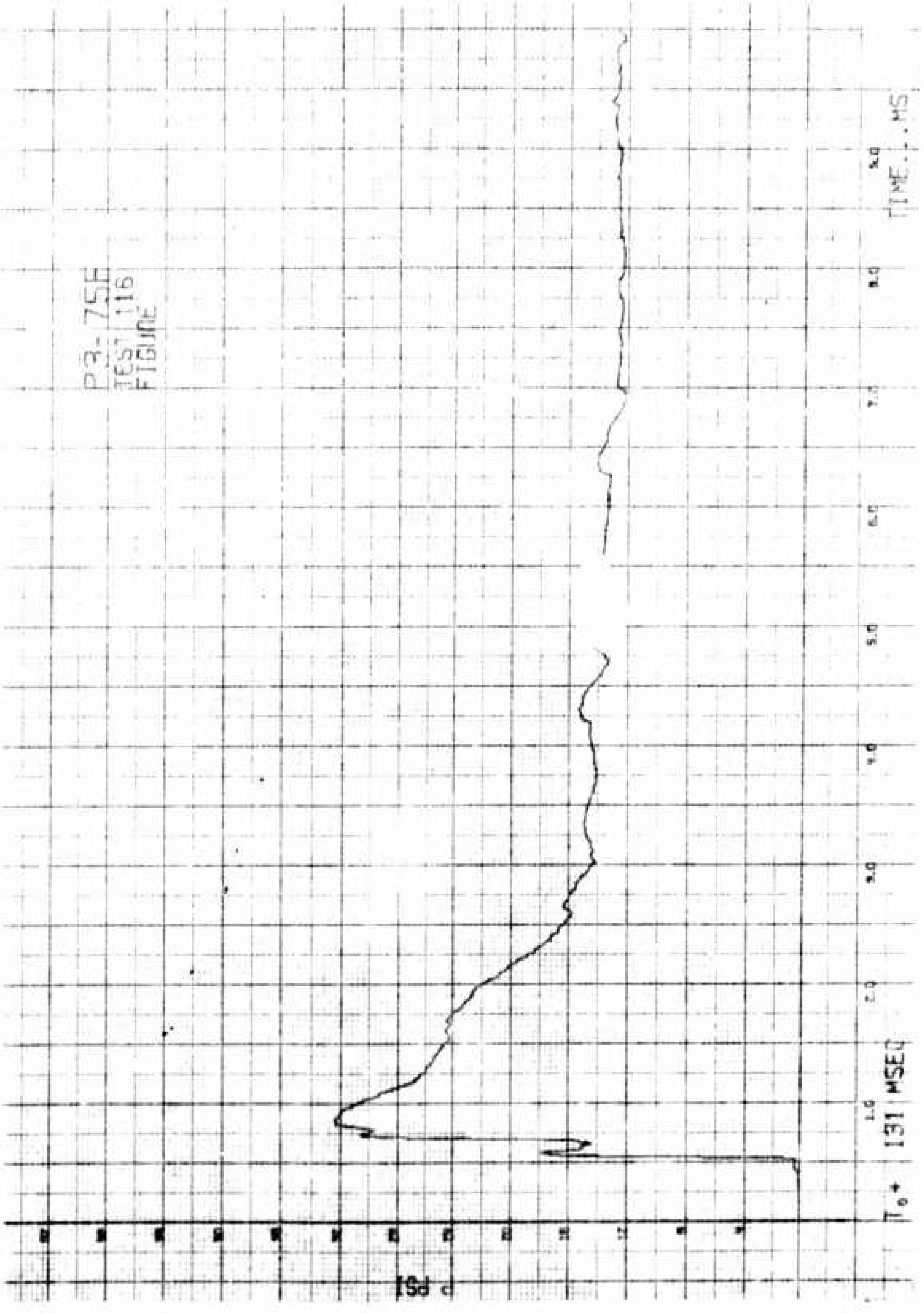
PRESSURE VS TIME ON FIN SIDE OF CONTROL SECTION

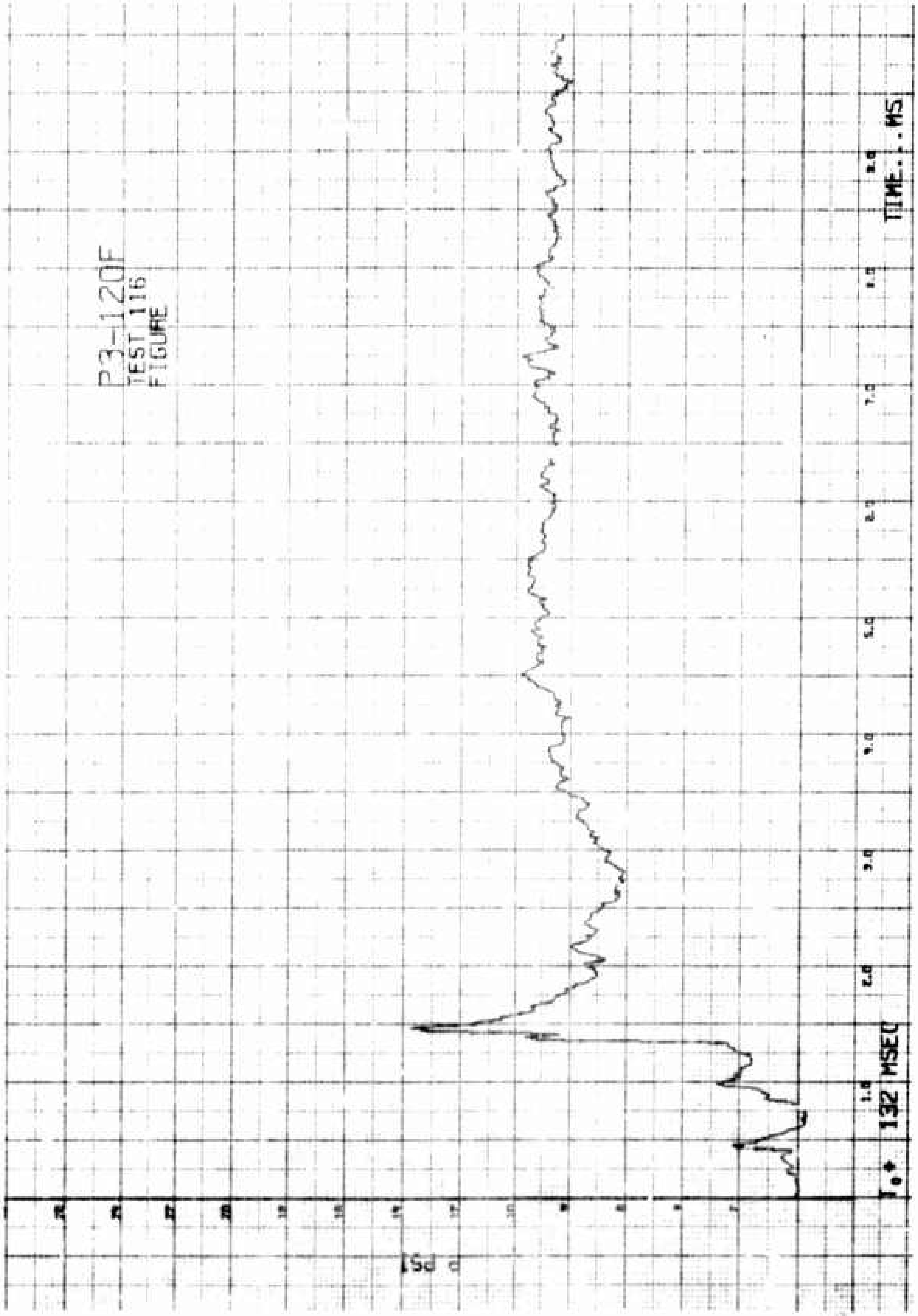

P3-60F
TEST 115
FIGURE
TIME...MS
148 MSEC
T_0 +
PSI


P3-105F
TEST 115
FIGURE
149 MSEC
TIME...MS
P PSI


P3-150F
TEST 115
FIGURE
150 MSEC
PSI


P3-30F
TEST 116
FIGURE
TIME...MS
130 MSEC
P PSI


P3- 75E
TEST 116
FIGURE
TIME . . MS
T0 + 131 MSEC
P PSI


P3-120F
TEST 116
FIGURE
TIME...MS
132 MSEC
P PSI

APPENDIX C

PRESSURE FUNCTION COEFFICIENTS

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASAGON TEST NO. 114

	TIME = .150	TIME = .550	TIME = .800	TIME = .900	TIME = 1.050	TIME = 1.625	TIME = 2.225	TIME = 2.850
B(1 1)	4.39510	39.77479	7.55780	5.08019	22.58485	3.63536	2.71323	3.10476
B(1 2)	3.63140	-32.32486	1.21297	2.36508	-25.25539	.09387	.28404	-.68168
B(1 3)	I	-.28739	-.02532	-.01346	12.22158	.83144	.76191	.69361
B(1 4)	I	.28664	.00888	-.00150	-.42186	.17427	-.49931	-.26550
B(1 5)	I	I	I	I	.66563	.02660	.92873	.44158
B(1 6)	I	I	I	I	-.30416	.01317	.02502	.78232
B(2 1)	I	I	I	I	.00225	.00147	.02089	.00994
B(2 2)	I	I	I	I	-.00365	-.01231	-.00368	.03546
B(2 3)	I	I	I	I	.00168	-.00019	.00916	.00795
B(2 4)	I	I	I	I	I	-.00000	-.02332	.00406
B(2 5)	I	I	I	I	I	-.00007	-.00015	-.01143
B(2 6)	I	I	I	I	I	.00011	-.00008	-.02079
B(3 1)	I	I	I	I	I	I	-.00002	-.00007
B(3 2)	I	I	I	I	I	I	-.00001	-.00015
B(3 3)	I	I	I	I	I	I	.00011	-.00008
B(3 4)	I	I	I	I	I	I	I	-.00000
B(3 5)	I	I	I	I	I	I	I	.00005
B(3 6)	I	I	I	I	I	I	I	.00011

	TIME = 2.950	TIME = 3.050	TIME = 3.150	TIME = 3.250	TIME = 3.350	TIME = 3.450	TIME = 3.550	TIME = 3.650
B(1 1)	3.15154	3.17509	3.24564	3.31841	3.37736	3.41703	3.49279	3.65333
B(1 2)	-.81173	-.84708	-.97968	-1.19361	-1.34965	-1.49021	-1.70364	-1.93340
B(1 3)	.75195	.63580	.63057	.58901	.53927	.48047	.45136	.42007
B(1 4)	-.23696	-.09112	.09619	.28196	.47757	.69657	.87999	1.10790
B(1 5)	.40631	.32181	.19271	.10700	.03960	-.00322	-.04184	-.16794
B(1 6)	.76288	.73526	.76215	.90469	.99250	1.04359	1.11455	1.15865
B(2 1)	.00718	.00669	.00540	.00402	.00304	.00295	.00134	-.00247
B(2 2)	.04023	.03993	.04201	.04547	.04758	.04934	.05452	.06001
B(2 3)	.00310	.00516	.00717	.00856	.01004	.01199	.01187	.01134
B(2 4)	.00694	.00434	.00031	-.00488	-.01118	-.01850	-.02376	-.02908
B(2 5)	-.01184	-.00831	-.00414	-.00221	-.00049	.00084	.00099	.00363
B(2 6)	-.01907	-.02017	-.02193	-.02657	-.02956	-.03173	-.03373	-.03596
B(3 1)	-.00004	-.00004	-.00004	-.00003	-.00003	-.00004	-.00003	-.00001
B(3 2)	-.00019	-.00019	-.00020	-.00022	-.00023	-.00024	-.00027	-.00031
B(3 3)	-.00004	-.00004	-.00005	-.00006	-.00006	-.00007	-.00007	-.00006
B(3 4)	-.00004	-.00003	-.00002	.00001	.00005	.00009	.00013	.00016
B(3 5)	.00006	.00004	.00002	.00001	.00001	.00001	.00001	-.00001
B(3 6)	.00009	.00010	.00011	.00014	.00015	.00015	.00019	.00019

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION R(S,THETA)

DASACON TEST NO. 114

	TIME = 3.750	TIME = 3.850	TIME = 3.950	TIME = 4.050	TIME = 4.150	TIME = 4.250	TIME = 4.350	TIME = 4.450
B(1 1)	3.75783	3.75283	3.68229	3.63864	3.55082	3.47159	3.43429	3.41956
B(1 2)	-2.07865	-2.09554	-1.93312	-1.75759	-1.46125	-1.18367	-.92348	-.67048
B(1 3)	.34291	.35138	.33335	.32511	.31053	.27410	.24199	.22055
B(1 4)	1.29802	1.38300	1.35405	1.28468	1.18222	1.11283	1.03295	.91762
B(1 5)	-.23906	-.22817	-.10991	-.01064	.12368	.24128	.31776	.34618
B(1 6)	1.14202	1.09704	.94907	.79866	.56983	.35525	.16525	.01205
B(2 1)	-.00489	-.00515	-.00331	-.00303	-.00122	.00062	.00142	.00190
B(2 2)	.06316	.06237	.05792	.05321	.04428	.03569	.02774	.02052
B(2 3)	.01093	.01062	.01125	.01129	.01263	.01489	.01660	.01744
B(2 4)	-.03359	-.03646	-.03664	-.03446	-.03165	-.02990	-.02784	-.02467
B(2 5)	.00522	.00474	.00054	-.00389	-.00904	-.01335	-.01582	-.01648
B(2 6)	-.03633	-.03506	-.03025	-.02510	-.01785	-.01101	-.00486	-.00013
B(3 1)	-.00000	-.00000	-.00001	-.00001	-.00002	-.00003	-.00004	-.00004
B(3 2)	-.00033	-.00033	-.00031	-.00028	-.00023	-.00018	-.00014	-.00010
B(3 3)	-.00005	-.00004	-.00004	-.00004	-.00005	-.00006	-.00007	-.00007
B(3 4)	.00018	.00020	.00020	.00019	.00017	.00016	.00014	.00012
B(3 5)	-.00002	-.00001	.00001	.00004	.00007	.00010	.00011	.00011
B(3 6)	.00020	.00020	.00017	.00014	.00010	.00006	.00003	.00000

	TIME = 4.550	TIME = 4.650	TIME = 4.750	TIME = 4.850	TIME = 4.950	TIME = 5.050	TIME = 5.150	TIME = 5.250
B(1 1)	3.45856	3.47815	3.48624	3.48344	3.44228	3.39428	3.35260	3.74246
B(1 2)	-.46760	-.27507	-.10172	.03462	.16484	.29518	.40541	.49764
B(1 3)	.20593	.20089	.20319	.20372	.21204	.21251	.21307	.21282
B(1 4)	.80242	.67503	.53980	.42488	.30117	.16526	.06191	-.04555
B(1 5)	.32780	.32724	.33422	.34948	.39523	.44182	.47511	.47638
B(1 6)	-.08605	-.16957	-.21413	-.24379	-.25554	-.25793	-.26153	-.24597
B(2 1)	.00088	.00046	.00037	.00068	.00214	.00376	.00514	.00538
B(2 2)	.01516	.01019	.00549	.00182	-.00180	-.00545	-.00843	-.01085
B(2 3)	.01778	.01789	.01724	.01655	.01584	.01541	.01489	.01461
B(2 4)	-.02157	-.01822	-.01458	-.01159	-.00839	-.00465	-.00171	.00141
B(2 5)	-.01582	-.01516	-.01483	-.01468	-.01581	-.01698	-.01775	-.01773
B(2 6)	.00263	.00501	.00512	.00703	.00749	.00761	.00764	.00695
B(3 1)	-.00003	-.00003	-.00003	-.00003	-.00004	-.00005	-.00006	-.00006
B(3 2)	-.00007	-.00004	-.00002	-.00000	.00002	.00003	.00005	.00006
B(3 3)	-.00008	-.00008	-.00007	-.00007	-.00006	-.00006	-.00006	-.00006
B(3 4)	.00011	.00009	.00007	.00006	.00005	.00003	.00001	-.00000
B(3 5)	.00010	.00010	.00009	.00009	.00009	.00010	.00010	.00010
B(3 6)	-.00002	-.00003	-.00004	-.00004	-.00005	-.00005	-.00005	-.00005

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 114

	TIME = 5.350	TIME = 5.450	TIME = 5.550	TIME = 5.650	TIME = 5.750	TIME = 5.850	TIME = 5.950	TIME = 6.050
B(1 1)	3.35024	3.34770	3.35841	3.40622	3.49117	3.57517	3.65598	3.69864
B(1 2)	.58398	.67799	.77976	.83660	.85415	.81278	.72199	.6619
B(1 3)	.19583	.17275	.16065	.14968	.14476	.13503	.13975	.14380
B(1 4)	-.11936	-.16555	-.20825	-.24468	-.30248	-.33383	-.36909	-.38916
B(1 5)	.45110	.44189	.43336	.39255	.31503	.24952	.18223	.15307
B(1 6)	-.24238	-.26582	-.30196	-.30649	-.25638	-.18918	-.07536	.00089
B(2 1)	.00494	.00463	.00378	.00183	-.00130	-.00436	-.00716	-.00865
B(2 2)	-.01314	-.01527	-.01778	-.01925	-.01975	-.01873	-.01617	-.01463
B(2 3)	.01488	.01549	.01594	.01648	.01699	.01769	.01769	.01756
B(2 4)	.00358	.00496	.00521	.00745	.00924	.01044	.01167	.01245
B(2 5)	-.01700	-.01657	-.01602	-.01443	-.01196	-.01004	-.00793	-.00707
B(2 6)	.00662	.00681	.00719	.00663	.00461	.00229	-.00128	-.00353
B(3 1)	-.00006	-.00006	-.00005	-.00004	-.00002	.00001	.00003	.00004
B(3 2)	.00007	.00008	.00009	.00009	.00009	.00008	.00007	.00006
B(3 3)	-.00006	-.00006	-.00007	-.00007	-.00007	-.00008	-.00008	-.00008
B(3 4)	-.00002	-.00002	-.00003	-.00004	-.00005	-.00006	-.00006	-.00007
B(3 5)	.00010	.00010	.00010	.00008	.00007	.00006	.00004	.00004
B(3 6)	-.00005	-.00005	-.00005	-.00004	-.00003	-.00001	.00001	.00003

	TIME = 6.150	TIME = 6.250	TIME = 6.350	TIME = 6.450	TIME = 6.550	TIME = 6.650	TIME = 6.750	TIME = 6.850
B(1 1)	3.72903	3.78704	3.83170	3.88127	3.89539	3.90690	3.90162	3.89966
B(1 2)	.59823	.51784	.44866	.38235	.33440	.27605	.24501	.20350
B(1 3)	.14653	.15175	.14826	.15155	.15780	.16868	.18426	.20016
B(1 4)	-.35886	-.26667	-.18274	-.10069	-.04112	.01994	.06491	.12106
B(1 5)	.13297	.09563	.05754	.01824	.00349	-.01488	-.02030	-.02219
B(1 6)	.02034	.00597	-.01052	-.02296	-.04013	-.05530	-.08398	-.10526
B(2 1)	-.00955	-.01132	-.01271	-.01430	-.01478	-.01506	-.01487	-.01474
B(2 2)	-.01290	-.01058	-.00856	-.00670	-.00545	-.00394	-.00315	-.00193
B(2 3)	.01754	.01725	.01721	.01692	.01665	.01608	.01541	.01471
B(2 4)	.01169	.00384	.00639	.00405	.00245	.00095	-.00020	-.00180
B(2 5)	-.00654	-.00504	-.00400	-.00264	-.00212	-.00169	-.00148	-.00128
B(2 6)	-.00388	-.00317	-.00239	-.00185	-.00146	-.00119	-.00047	-.00002
B(3 1)	.00004	.00005	.00006	.00007	.00008	.00008	.00008	.00008
B(3 2)	.00005	.00003	.00002	.00001	-.00000	-.00001	-.00001	-.00002
B(3 3)	-.00008	-.00008	-.00008	-.00008	-.00008	-.00008	-.00008	-.00007
B(3 4)	-.00007	-.00005	-.00003	-.00002	-.00001	.00000	.00001	.00002
B(3 5)	.00003	.00002	.00001	.00001	.00000	.00000	.00000	.00000
B(3 6)	.00003	.00002	.00002	.00001	.00001	.00001	.00001	.00000

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 114

	TIME = 6.950	TIME = 7.050	TIME = 7.150	TIME = 7.250	TIME = 7.350	TIME = 7.450	TIME = 7.550	TIME = 7.650
B(1 1)	3.88529	3.85027	3.81195	3.76253	3.73198	3.70961	3.69706	3.68497
B(1 2)	.14599	.12045	.09291	.07916	.08750	.11159	.14445	.16792
B(1 3)	.20817	.22210	.23671	.25632	.26919	.26774	.26596	.26037
B(1 4)	.18073	.22573	.29597	.36918	.40043	.41104	.41164	.42168
B(1 5)	-.01636	-.00397	.00737	.01539	.01268	-.00327	-.04000	-.08900
B(1 6)	-.10716	-.13051	-.16431	-.21317	-.23620	-.24827	-.24924	-.22093
B(2 1)	.01420	-.01319	-.01209	-.01059	-.00965	-.00905	-.00880	-.00855
B(2 2)	-.00026	.00058	.00157	.00218	.00205	.00153	.00075	.00021
B(2 3)	.01395	.01302	.01199	.01086	.00996	.00949	.00907	.00856
B(2 4)	-.00347	-.00477	-.00579	-.00889	-.00965	-.00980	-.00972	-.00981
B(2 5)	-.00128	-.00141	-.00144	-.00138	-.00110	-.00041	.00080	.00235
B(2 6)	-.00001	.00072	.00165	.00306	.00369	.00399	.00392	.00312
B(3 1)	.00007	.00007	.00006	.00005	.00004	.00004	.00004	.00004
B(3 2)	-.00003	-.00003	-.00004	-.00004	-.00004	-.00004	-.00003	-.00003
B(3 3)	-.00007	-.00006	-.00006	-.00005	-.00004	-.00004	-.00004	-.00003
B(3 4)	.00003	.00004	.00005	.00006	.00007	.00006	.00006	.00006
B(3 5)	.00000	.00000	.00000	.00000	.00000	-.00000	-.00001	-.00002
B(3 6)	.00000	-.00000	-.00001	-.00002	-.00002	-.00002	-.00002	-.00002

TABLE OF COEFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 115

	TIME = .150	TIME = .500	TIME = .700	TIME = .800	TIME = .900	TIME = 1.450	TIME = 2.000	TIME = 2.600
B(1 1)	11.32535	48.89845	7.69466	14.89775	45.65451	8.86900	6.06993	6.57876
B(1 2)	12.37215	-24.47975	18.46608	10.02603	-38.53431	2.23363	3.49405	1.48890
B(1 3)	I	-.27461	.03197	-.04129	13.28123	3.72223	3.60880	2.78968
B(1 4)	I	.25694	-.06856	.01027	-.56009	-.69881	-2.29045	-3.69375
B(1 5)	I	I	I	I	.81142	.08960	.90359	1.82788
B(1 6)	I	I	I	I	-.18645	.00995	.07826	3.21334
B(2 1)	I	I	I	I	.00250	.00374	.01387	.02725
B(2 2)	I	I	I	I	-.00383	.01057	-.00413	.06254
B(2 3)	I	I	I	I	.00086	-.00055	.04442	.03605
B(2 4)	I	I	I	I	I	.00005	-.00776	.08453
B(2 5)	I	I	I	I	I	-.00009	-.00042	-.04845
B(2 6)	I	I	I	I	I	-.00000	.00007	-.07864
B(3 1)	I	I	I	I	I	I	-.00012	-.00009
B(3 2)	I	I	I	I	I	I	-.00012	-.00028
B(3 3)	I	I	I	I	I	I	-.00007	-.00024
B(3 4)	I	I	I	I	I	I	I	-.00045
B(3 5)	I	I	I	I	I	I	I	.00023
B(3 6)	I	I	I	I	I	I	I	.00039

	TIME = 2.700	TIME = 2.800	TIME = 2.900	TIME = 3.000	TIME = 3.100	TIME = 3.200	TIME = 3.300	TIME = 3.400
B(1 1)	6.57591	6.69475	6.76682	6.93086	7.31427	7.83611	8.46697	8.94655
B(1 2)	1.21994	.84932	.49178	.28973	.04854	-.33296	-.88465	-1.33798
B(1 3)	2.66490	2.50298	2.34753	2.13525	1.92630	1.74812	1.60598	1.49159
B(1 4)	-3.70640	-3.62471	-3.54488	-3.30668	-2.45664	-1.03972	.60431	2.07424
B(1 5)	1.91418	1.92652	1.90364	1.76980	1.38945	.86481	.18456	-.40158
B(1 6)	3.66471	4.14574	4.62905	4.87658	4.55975	3.76958	2.90043	2.04988
B(2 1)	.02446	.01877	.01456	.00936	-.00129	-.01388	-.02887	-.04094
B(2 2)	.06538	.07159	.07659	.07678	.07926	.08573	.09769	.10866
B(2 3)	.04324	.05154	.06028	.07012	.07878	.08224	.08172	.08837
B(2 4)	.08215	.07639	.07031	.05963	.03525	.00228	-.03335	-.06562
B(2 5)	-.05193	-.05339	-.05297	-.04612	-.03202	-.01683	-.00052	.01259
B(2 6)	-.08962	-.10224	-.11584	-.12671	-.12759	-.11725	-.10299	-.08602
B(3 1)	-.00008	-.00005	-.00003	-.00001	.00004	.00010	.00017	.00022
B(3 2)	-.00029	-.00033	-.00036	-.00036	-.00037	-.00041	-.00047	-.00053
B(3 3)	-.00028	-.00032	-.00036	-.00041	-.00045	-.00046	-.00044	-.00042
B(3 4)	-.00043	-.00040	-.00037	-.00031	-.00018	-.00002	.00015	.00031
B(3 5)	.00025	.00026	.00026	.00023	.00015	.00007	-.00001	-.00007
B(3 6)	.00044	.00051	.00058	.00064	.00066	.00062	.00056	.00048

TABLE OF COEFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 115

	TIME = 3.500	TIME = 3.600	TIME = 3.700	TIME = 3.800	TIME = 3.900	TIME = 4.000	TIME = 4.100	TIME = 4.200
B(1 1)	9.64903	10.43102	10.60408	10.19507	9.48226	9.29744	9.22400	9.14628
B(1 2)	-2.36819	-3.84068	-4.41106	-3.89217	-2.72040	-2.19932	-1.80151	-1.65818
B(1 3)	1.38944	1.25198	1.13402	.93114	.71618	.54556	.48999	.40973
B(1 4)	3.50757	4.53895	4.59821	4.40623	4.34724	4.83132	5.40463	5.78741
B(1 5)	-1.18636	-2.04058	-2.27629	-1.82276	-1.05281	-.81719	-.60654	-.51684
B(1 6)	1.77898	2.33580	2.97004	2.72823	1.67674	.72795	-.39278	-.90427
B(2 1)	-.05811	-.08035	-.09001	-.08382	-.06674	-.06113	-.05861	-.05733
B(2 2)	.13462	.17422	.19205	.17721	.14306	.11862	.10215	.09281
B(2 3)	.07901	.08307	.09068	.10334	.11651	.12505	.12767	.13453
B(2 4)	-.09386	-.11342	-.11477	-.11094	-.10810	-.11479	-.12036	-.12637
B(2 5)	.02929	.04847	.05221	.03504	.00697	-.00763	-.02527	-.03345
B(2 6)	-.08628	-.10760	-.12475	-.11369	-.07863	-.04983	-.01438	.00145
B(3 1)	.00031	.00044	.00051	.00048	.00039	.00035	.00033	.00031
B(3 2)	-.00069	-.00094	-.00107	-.00099	-.00078	-.00064	-.00054	-.00047
B(3 3)	-.00040	-.00041	-.00045	-.00052	-.00060	-.00064	-.00064	-.00068
B(3 4)	.00044	.00053	.00053	.00051	.00049	.00051	.00051	.00053
B(3 5)	-.00016	-.00028	-.00030	-.00021	-.00004	.00005	.00018	.00024
B(3 6)	.00051	.00067	.00078	.00072	.00052	.00035	.00014	.00004

	TIME = 4.300	TIME = 4.400	TIME = 4.500	TIME = 4.600	TIME = 4.700	TIME = 4.800	TIME = 4.900	TIME = 5.000
B(1 1)	9.05837	8.98619	8.92900	8.95253	9.03399	9.04496	8.80842	8.37845
B(1 2)	-1.50136	-1.34112	-1.10670	-.93926	-.82351	-.80659	-.65549	-.25487
B(1 3)	.34194	.27235	.19565	.10472	.01933	-.01926	-.01676	-.01180
B(1 4)	6.05324	6.29464	6.46279	6.65460	6.88512	7.04892	6.96398	6.50455
B(1 5)	-.45135	-.40391	-.36965	-.39613	-.48438	-.51391	-.31580	.03081
B(1 6)	-1.27723	-1.65215	-2.06027	-2.43579	-2.79967	-2.95466	-2.97731	-2.82671
B(2 1)	-.05685	-.05720	-.05555	-.05289	-.05003	-.04850	-.04110	-.02847
B(2 2)	.08497	.07350	.07093	.06662	.06550	.06763	.06387	.05118
B(2 3)	.14102	.14591	.14432	.13302	.11536	.10357	.09555	.08942
B(2 4)	-.13133	-.13566	-.13819	-.14133	-.14604	-.14968	-.14676	-.13124
B(2 5)	-.03805	-.03998	-.03609	-.02207	-.00093	.01183	.01227	.00497
B(2 6)	.01250	.02282	.03433	.04398	.05186	.05300	.05214	.04734
B(3 1)	.00031	.00031	.00029	.00027	.00025	.00023	.00018	.00010
B(3 2)	-.00041	-.00037	-.00032	-.00030	-.00030	-.00032	-.00030	-.00023
B(3 3)	-.00072	-.00075	-.00073	-.00064	-.00051	-.00042	-.00036	-.00031
B(3 4)	.00055	.00057	.00058	.00059	.00061	.00063	.00062	.00054
B(3 5)	.00027	.00029	.00025	.00015	.00000	-.00009	-.00010	-.00006
B(3 6)	-.00002	-.00007	-.00014	-.00019	-.00023	-.00023	-.00023	-.00021

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 115

	TIME = 5.100	TIME = 5.200	TIME = 5.300	TIME = 5.400	TIME = 5.500	TIME = 5.600	TIME = 5.700	TIME = 5.800
B(1 1)	7.93912	7.61161	7.49328	8.04182	8.97420	8.32278	8.03237	8.14076
B(1 2)	.15266	.50089	.78287	1.57022	3.03605	2.74582	2.22563	2.00337
B(1 3)	-.00181	.05335	.24927	.44017	.65241	1.01228	1.52452	1.92687
B(1 4)	6.00655	5.57107	5.04392	1.39792	.81710	1.59428	2.12665	2.00663
B(1 5)	.38234	.69139	.79260	.32647	-.45356	.20018	.29809	.14683
B(1 6)	-2.60908	-2.46934	-2.32603	-1.68925	-.92205	-1.77056	-2.11067	-2.12763
B(2 1)	-.01632	-.00730	-.00749	-.01222	-.02633	-.01210	-.00664	-.00863
B(2 2)	.03765	.02497	.01509	-.00397	-.03932	-.04002	-.03106	-.02725
B(2 3)	.08527	.07983	.07189	.06191	.05133	.04561	.03377	.02264
B(2 4)	-.11492	-.10161	-.08762	-.05289	.00050	-.00840	-.01466	-.00960
B(2 5)	-.00509	-.01446	-.01844	-.01170	-.00142	-.01739	-.01751	-.01268
B(2 6)	.04075	.03660	.03240	.01982	.00796	.02614	.03098	.03073
B(3 1)	.00003	-.00001	-.00003	.00001	.00007	-.00000	-.00002	-.00001
B(3 2)	-.00015	-.00008	-.00002	.00007	.00025	.00026	.00021	.00019
B(3 3)	-.00028	-.00025	-.00020	-.00014	-.00007	-.00004	.00002	.00008
B(3 4)	.00045	.00039	.00033	.00017	-.00009	-.00006	-.00004	-.00006
B(3 5)	-.00000	.00004	.00006	.00003	-.00001	.00006	.00005	.00002
B(3 6)	-.00019	-.00018	-.00017	-.00011	-.00007	-.00015	-.00016	-.00015

	TIME = 5.900	TIME = 6.000	TIME = 6.100	TIME = 6.200	TIME = 6.300	TIME = 6.400	TIME = 6.500	TIME = 6.600
B(1 1)	8.42715	8.78487	9.22479	9.46431	9.57348	9.74547	9.92952	10.09829
B(1 2)	2.03104	2.01072	1.77276	1.63711	1.66900	1.52738	1.25924	1.02316
B(1 3)	1.8[illegible]869	1.61517	1.43823	1.34740	1.33660	1.41924	1.57678	1.74376
B(1 4)	1.71850	1.49076	1.32186	1.24204	1.20058	1.26020	1.35600	1.41431
B(1 5)	-.13240	-.55709	-.98520	-1.19006	-1.29174	-1.44738	-1.72042	-1.98782
B(1 6)	-1.80405	-1.24079	-.65473	-.33909	-.30436	-.25624	-.14541	-.02863
B(2 1)	-.01428	-.02163	-.03099	-.03568	-.03816	-.04292	-.04817	-.05305
B(2 2)	-.02848	-.02787	-.02265	-.02055	-.02172	-.01756	-.00962	-.00223
B(2 3)	.02240	.02699	.03073	.03245	.03153	.02804	.02231	.01606
B(2 4)	-.00175	.00457	.00903	.01188	.01293	.01074	.00757	.00544
B(2 5)	-.00623	.00375	.01336	.01253	.01927	.02526	.03382	.04214
B(2 6)	.02371	.01127	-.00072	-.00630	-.00559	-.00521	-.00679	-.00892
B(3 1)	.00002	.00006	.00011	.00014	.00015	.00018	.00021	.00024
B(3 2)	.00019	.00017	.00014	.00012	.00013	.00012	.00005	.00001
B(3 3)	.00008	.00006	.00004	.00003	.00004	.00006	.00009	.00012
B(3 4)	-.00010	-.00013	-.00015	-.00016	-.00016	-.00013	-.00011	-.00009
B(3 5)	-.00002	-.00008	-.00013	-.00016	-.00017	-.00020	-.00026	-.00031
B(3 6)	-.00012	-.00005	.00001	.00003	.00002	.00001	.00001	.00002

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

PASACON TEST NO. 115

	TIME = 6.700	TIME = 6.800	TIME = 6.900	TIME = 7.000	TIME = 7.100	TIME = 7.200	TIME = 7.300	TIME = 7.400
B(1 1)	10.31052	10.51453	10.73981	10.85177	10.95433	11.04947	11.11895	11.05325
B(1 2)	.45459	.74520	.65290	.65053	.64838	.68409	.81327	1.02006
B(1 3)	1.76603	1.75559	1.69942	1.61935	1.51565	1.43004	1.34448	1.45109
B(1 4)	1.41794	1.36385	1.32937	1.24676	1.14258	.99396	.77727	.47715
B(1 5)	-2.16075	-2.32355	-2.47136	-2.57807	-2.64497	-2.71781	-2.77105	-2.97221
B(1 6)	.08530	.22139	.36317	.49466	.56432	.85419	1.01958	1.16016
B(2 1)	-.05902	-.06466	-.07058	-.07489	-.07831	-.08179	-.08449	-.08379
B(2 2)	.00306	.00555	.00973	.01043	.01139	.01157	.00963	.00532
B(2 3)	.01361	.01216	.01710	.01527	.01896	.02288	.02635	.02508
B(2 4)	.00479	.00514	.00495	.00616	.00821	.01140	.01615	.02291
B(2 5)	.04798	.05359	.05795	.06060	.06196	.06719	.06382	.06535
B(2 6)	-.01109	-.01408	-.01770	-.02067	-.02467	-.02966	-.03385	-.03724
B(3 1)	.00028	.00031	.00035	.00038	.00040	.00042	.00044	.00044
B(3 2)	-.00003	-.00006	-.00008	-.00009	-.00010	-.00011	-.00011	-.00009
B(3 3)	.00014	.00015	.00014	.00013	.00010	.00007	.00003	.00003
B(3 4)	-.00008	-.00007	-.00006	-.00006	-.00007	-.00008	-.00010	-.00013
B(3 5)	-.00035	-.00033	-.00041	-.00042	-.00043	-.00043	-.00043	-.00044
B(3 6)	.00003	.00005	.00007	.00009	.00011	.00014	.00017	.00018

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 116

	TIME = .150	TIME = .550	TIME = .750	TIME = .900	TIME = 1.000	TIME = 1.500	TIME = 2.050	TIME = 2.600
B(1 1)	9.71413	7.74111	18.80843	13.38251	3.47719	4.67009	5.71927	7.40691
B(1 2)	14.70687	15.22577	6.85520	7.33990	17.41475	4.72625	3.40297	.39078
B(1 3)	I	.05129	-.06022	-.03660	-.37267	5.44676	2.53090	.79887
B(1 4)	I	-.06051	.05114	.03697	.00242	-.41890	-2.00642	-2.03788
B(1 5)	I	I	I	I	.03632	.26052	3.05049	2.59596
B(1 6)	I	I	I	I	-.08490	-.25497	.07370	3.92424
B(2 1)	I	I	I	I	.00074	.10545	-.00298	.01703
B(2 2)	I	I	I	I	-.00137	-.09140	.02242	.04942
B(2 3)	I	I	I	I	.00095	-.00181	.02678	.09402
B(2 4)	I	I	I	I	I	.00231	-.05371	.02128
B(2 5)	I	I	I	I	I	-.00130	-.00038	-.03939
B(2 6)	I	I	I	I	I	.00084	.00021	-.10518
B(3 1)	I	I	I	I	I	I	-.00025	-.00007
B(3 2)	I	I	I	I	I	I	-.00001	-.00011
B(3 3)	I	I	I	I	I	I	.00018	-.00057
B(3 4)	I	I	I	I	I	I	I	-.00007
B(3 5)	I	I	I	I	I	I	I	.00014
B(3 6)	I	I	I	I	I	I	I	.00057

	TIME = 2.700	TIME = 2.800	TIME = 2.900	TIME = 3.000	TIME = 3.100	TIME = 3.200	TIME = 3.300	TIME = 3.400
B(1 1)	7.68323	8.00019	8.54499	9.12297	9.49247	9.71953	9.90172	10.30340
B(1 2)	-.10235	-.79067	-1.67146	-2.44653	-2.93082	-3.26494	-3.61547	-4.46440
B(1 3)	.65204	.55513	.44649	.36319	.36472	.40921	.48897	.58500
B(1 4)	-1.78304	-1.19394	-.01371	1.34026	2.40160	3.16782	3.75729	4.20822
B(1 5)	2.45897	2.25740	1.51776	1.30738	.94055	.67159	.39531	-.12907
B(1 6)	4.25076	4.40129	4.15330	3.58332	2.96197	2.46117	2.17727	2.53086
B(2 1)	.00671	-.00342	-.01569	-.02705	-.03477	-.04005	-.04428	-.05590
B(2 2)	.35901	.07756	.08882	.10267	.11118	.11655	.12454	.15048
B(2 3)	.1015	.13330	.10670	.10595	.10475	.10431	.09959	.09177
B(2 4)	.01522	.00231	-.02144	-.04695	-.06829	-.08421	-.09756	-.10815
B(2 5)	-.03804	-.03525	-.02508	-.01294	-.00422	.00237	.01222	.03189
B(2 6)	-.11154	-.11495	-.11107	-.10151	-.08967	-.08053	-.07764	-.09432
B(3 1)	-.00001	.00004	.00010	.00014	.00017	.00019	.00021	.00028
B(3 2)	-.00016	-.00024	-.00032	-.00039	-.00043	-.00046	-.00051	-.00069
B(3 3)	-.00060	-.00061	-.00063	-.00058	-.00056	-.00055	-.00051	-.00045
B(3 4)	-.00095	.00000	.00011	.00022	.00031	.00039	.00045	.00030
B(3 5)	.00014	.00014	.00009	.00004	-.00003	-.00003	-.00009	-.00022
B(3 6)	.00059	.00060	.00057	.00053	.00047	.00043	.00043	.00056

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 115

	TIME = 3.500	TIME = 3.600	TIME = 3.700	TIME = 3.800	TIME = 3.900	TIME = 4.000	TIME = 4.100	TIME = 4.200
B(1 1)	10.84328	10.99544	10.26009	9.30078	8.88372	8.75419	8.72107	8.58570
B(1 2)	-5.62440	-5.13093	-5.10167	-3.61860	-2.98190	-2.78748	-2.73068	-2.59464
B(1 3)	.59726	.83470	.92007	1.02947	1.07783	1.09752	1.20871	1.22649
B(1 4)	4.60534	4.90516	5.34417	5.78698	6.25341	6.68719	7.01041	7.28951
B(1 5)	-.82978	-1.22321	-.81292	-.22416	-.07003	-.16227	-.21652	-.23995
B(1 6)	3.24835	3.40335	2.10867	.35638	-.57516	-1.03567	-1.46133	-1.76794
B(2 1)	-.07345	-.07947	-.05999	-.03385	-.02442	-.02449	-.02864	-.02840
B(2 2)	.18668	.20225	.17029	.12378	.10331	.09686	.09716	.09265
B(2 3)	.04563	.09032	.09100	.08310	.08511	.08745	.08222	.08069
B(2 4)	-.11708	-.12416	-.13134	-.13969	-.14991	-.15571	-.15733	-.16022
B(2 5)	.05527	.05685	.05099	.02835	.01973	.01936	.01550	.01346
B(2 6)	-.12130	-.12302	-.09124	-.04022	-.01460	-.00494	.00873	.01739
B(3 1)	.00039	.00043	.00031	.00016	.00011	.00012	.00016	.00016
B(3 2)	-.00093	-.00104	-.00085	-.00059	-.00047	-.00045	-.00047	-.00045
B(3 3)	-.00040	-.00036	-.00037	-.00035	-.00039	-.00041	-.00036	-.00034
B(3 4)	.00054	.00057	.00060	.00064	.00067	.00070	.00068	.00069
B(3 5)	-.00037	-.00044	-.00034	-.00020	-.00015	-.00015	-.00012	-.00010
B(3 6)	.00075	.00081	.00060	.00031	.00017	.00013	.00007	.00002

	TIME = 4.300	TIME = 4.400	TIME = 4.500	TIME = 4.600	TIME = 4.700	TIME = 4.800	TIME = 4.900	TIME = 5.000
B(1 1)	8.44061	8.30644	8.21399	8.15330	8.09398	8.00535	7.53171	7.15754
B(1 2)	-2.41927	-2.19235	-2.01559	-1.76331	-1.61235	-1.49097	-1.06131	-.76533
B(1 3)	1.18013	1.13056	1.08642	1.09043	1.11505	1.15180	1.22796	1.30412
B(1 4)	7.46569	7.55714	7.70699	7.79033	7.95527	8.07118	7.14803	6.09495
B(1 5)	-.22776	-.15707	-.10107	-.11926	-.14123	-.12261	.29773	.62785
B(1 6)	-1.95295	-2.16573	-2.41784	-2.64353	-2.88147	-3.05928	-2.57751	-1.87109
B(2 1)	-.02787	-.02767	-.03026	-.03417	-.03886	-.04276	-.03345	-.02587
B(2 2)	.08672	.07363	.07560	.05864	.06551	.06378	.05228	.04453
B(2 3)	.08275	.08497	.08973	.08487	.09910	.10149	.09836	.09363
B(2 4)	-.16305	-.16477	-.16905	-.17303	-.18023	-.18531	-.15798	-.12660
B(2 5)	.01197	.01364	.00823	.00598	.00576	.00405	-.00876	-.01890
B(2 6)	.02186	.02587	.03361	.04037	.04775	.05297	.03780	.01617
B(3 1)	.00016	.00016	.00019	.00021	.00024	.00028	.00023	.00019
B(3 2)	-.00041	-.00037	-.00034	-.00031	-.00030	-.00030	-.00024	-.00021
B(3 3)	-.00035	-.00035	-.00039	-.00042	-.00045	-.00047	-.00045	-.00042
B(3 4)	.00070	.00070	.00073	.00076	.00081	.00086	.00072	.00055
B(3 5)	-.00009	-.00009	-.00008	-.00007	-.00006	-.00006	.00001	.00006
B(3 6)	-.00001	-.00003	-.00007	-.00011	-.00016	-.00020	-.00012	-.00001

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 116

	TIME = 5.100	TIME = 5.200	TIME = 5.300	TIME = 5.400	TIME = 5.500	TIME = 5.600	TIME = 5.700	TIME = 5.800
B(1 1)	7.26478	8.42303	9.54244	9.03308	8.76619	8.43831	8.12339	8.25994
B(1 2)	-.01932	1.36585	1.88226	1.60572	1.46741	1.27021	1.20414	1.61252
B(1 3)	1.29177	1.24244	1.20433	1.25779	1.29165	1.31594	1.26481	1.15633
B(1 4)	4.20165	.34533	-1.56307	-.81881	-.33624	.34976	.94019	.66225
B(1 5)	.61737	-.37485	-1.35612	-.79519	-.46957	-.04510	.40581	.43815
B(1 6)	-.84479	1.39987	2.61532	1.93698	1.49222	.83540	.13403	-.18809
B(2 1)	-.32454	-.04227	-.06493	-.05527	-.05125	-.04672	-.04172	-.04519
B(2 2)	.02700	-.00032	-.00601	-.00356	-.00211	.00030	-.00061	-.01021
B(2 3)	.08771	.07539	.06693	.06619	.05534	.05644	.06935	.07196
B(2 4)	-.07794	.01094	.05202	.04763	.03659	.02567	.01595	.02213
B(2 5)	-.02339	-.00708	.01403	.00108	-.00592	-.01612	-.02769	-.03069
B(2 6)	-.01065	-.06448	-.09406	-.08389	-.07528	-.06191	-.04539	-.03486
B(3 1)	.00018	.00024	.00035	.00031	.00030	.00028	.00026	.00028
B(3 2)	-.00012	.00001	.00002	.00001	-.00000	-.00002	-.00001	.00003
B(3 3)	-.00038	-.00029	-.00022	-.00022	-.00021	-.00022	-.00024	-.00025
B(3 4)	.00030	-.00015	-.00035	-.00031	-.00029	-.00024	-.00019	-.00021
B(3 5)	.00010	.00003	-.00008	-.00002	.00001	.00005	.00011	.00012
B(3 6)	.00013	.00041	.00057	.00053	.00050	.00043	.00035	.00028

	TIME = 5.900	TIME = 6.000	TIME = 6.100	TIME = 6.200	TIME = 6.300	TIME = 6.400	TIME = 6.500	TIME = 6.600
B(1 1)	8.70988	8.95556	9.15872	9.33498	9.49195	9.71813	9.99462	10.31582
B(1 2)	2.18405	2.44412	2.56577	2.64989	2.68090	2.60723	2.45928	2.31437
B(1 3)	.96957	.80592	.59161	.40734	.26325	.12207	.00350	-.09240
B(1 4)	.07356	-.00599	.12200	.29426	.47752	.75006	.99940	1.11830
B(1 5)	.24992	.22775	.25929	.27419	.24724	.12454	-.08401	-.36893
B(1 6)	-.34728	-.65440	-.96773	-1.23942	-1.43422	-1.56725	-1.57467	-1.43270
B(2 1)	-.05423	-.05991	-.06478	-.06888	-.07226	-.07778	-.08556	-.09572
B(2 2)	-.02216	-.02819	-.03160	-.03418	-.03504	-.03293	-.02896	-.02522
B(2 3)	.07491	.07344	.08315	.08765	.09124	.09541	.09989	.10446
B(2 4)	.03255	.03301	.02982	.02639	.02236	.01501	.00738	.00329
B(2 5)	-.02825	-.02888	-.03030	-.03189	-.03308	-.03198	-.02844	-.02269
B(2 6)	-.02671	-.01547	-.00655	.00211	.00890	.01441	.01698	.01505
B(3 1)	.00033	.00036	.00039	.00041	.00043	.00046	.00050	.00056
B(3 2)	.00008	.00011	.00012	.00013	.00014	.00012	.00010	.00007
B(3 3)	-.00026	-.00029	-.00030	-.00033	-.00035	-.00037	-.00040	-.00043
B(3 4)	-.00025	-.00024	-.00022	-.00019	-.00017	-.00012	-.00007	-.00003
B(3 5)	.00011	.00011	.00011	.00012	.00013	.00012	.00010	.00007
B(3 6)	.00023	.00016	.00010	.00004	.00000	-.00004	-.00006	-.00007

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 115

	TIME = 6.700	TIME = 6.800	TIME = 6.900	TIME = 7.000	TIME = 7.100	TIME = 7.200	TIME = 7.300	TIME = 7.400
B(1 1)	10.55303	10.77849	10.94793	11.06625	11.12973	11.19182	11.23050	11.24572
B(1 2)	2.17282	1.98059	1.81659	1.81584	2.02583	2.24279	2.44637	2.60169
B(1 3)	-.11923	-.15706	-.16672	-.15774	-.08045	-.07620	-.02056	-.01920
B(1 4)	1.18740	1.14987	1.03563	.84767	.56585	.33213	-.00719	-.36637
B(1 5)	-.63249	-.80376	-.84962	-.86536	-.99536	-1.12787	-1.23574	-1.33372
B(1 6)	-1.25884	-.99362	-.77359	-.65155	-.57629	-.49581	-.24889	.11683
B(2 1)	-.10379	-.11169	-.11758	-.11941	-.11575	-.11404	-.11293	-.11164
B(2 2)	-.02164	-.01724	-.01423	-.01541	-.02236	-.02901	-.03494	-.03978
B(2 3)	.10764	.11219	.11539	.11253	.09977	.09138	.08579	.08222
B(2 4)	.00058	.00099	.00385	.00871	.01569	.02126	.03064	.04108
B(2 5)	-.01819	-.01705	-.01990	-.01732	-.00559	.00339	.00941	.01378
B(2 6)	.01453	.01083	.00817	.00703	.00610	.00509	-.00052	-.00939
B(3 1)	.00061	.00066	.00069	.00070	.00067	.00065	.00064	.00063
B(3 2)	.00005	.00003	.00001	.00002	.00006	.00010	.00014	.00017
B(3 3)	-.00045	-.00049	-.00051	-.00050	-.00042	-.00037	-.00034	-.00032
B(3 4)	-.00001	-.00001	-.00002	-.00004	-.00004	-.00010	-.00016	-.00022
B(3 5)	.00005	.00005	.00006	.00006	-.00001	-.00006	-.00009	-.00011
B(3 6)	-.00007	-.00005	-.00005	-.00006	-.00005	-.00005	-.00003	.00002

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

PASAGON TEST NO. 117

	TIME = .200	TIME = .600	TIME = .750	TIME = .950	TIME = 1.100	TIME = 1.700	TIME = 2.300	TIME = 3.100
B(1 1)	8.70815	12.35077	12.44275	6.85584	12.07567	4.31237	2.77813	3.91281
B(1 2)	.83352	-3.37771	-3.96830	.95595	-10.40396	-.71778	-.03716	-1.82435
B(1 3)	I	-.03628	-.04657	-.00764	6.43307	1.94380	1.38628	1.08940
B(1 4)	I	.03564	.04514	.00891	-.23528	-.29698	-.61913	.99107
B(1 5)	I	I	I	I	.42413	-.01082	1.51047	.28048
B(1 6)	I	I	I	I	-.21105	.07751	.03037	.47531
B(2 1)	I	I	I	I	.00147	-.05814	.02861	.00087
B(2 2)	I	I	I	I	-.00262	.01664	-.00984	.05887
B(2 3)	I	I	I	I	.00129	.00004	.00503	.00519
B(2 4)	I	I	I	I	I	-.00032	-.03582	-.02618
B(2 5)	I	I	I	I	I	.00027	-.00017	-.00553
B(2 6)	I	I	I	I	I	-.00008	-.00307	-.01305
B(3 1)	I	I	I	I	I	I	-.00002	-.00001
B(3 2)	I	I	I	I	I	I	.00003	-.00025
B(3 3)	I	I	I	I	I	I	.00017	-.00009
B(3 4)	I	I	I	I	I	I	I	.00014
B(3 5)	I	I	I	I	I	I	I	.00003
B(3 6)	I	I	I	I	I	I	I	.00006

	TIME = 3.200	TIME = 3.300	TIME = 3.400	TIME = 3.500	TIME = 3.600	TIME = 3.700	TIME = 3.800	TIME = 3.900
B(1 1)	4.04044	4.12850	4.16367	4.20197	4.21587	4.13767	4.04058	3.97657
B(1 2)	-1.94843	-2.02189	-2.12881	-2.24634	-2.28199	-2.10483	-1.85178	-1.63492
B(1 3)	1.05461	1.02872	.98980	.94114	.87149	.78444	.71303	.65791
B(1 4)	1.11741	1.25380	1.35915	1.43484	1.51281	1.57380	1.57495	1.57731
B(1 5)	.17706	.12556	.12511	.11493	.12166	.22358	.34519	.43135
B(1 6)	.47653	.51173	.57464	.64584	.62489	.41670	.19736	.00412
B(2 1)	-.00266	-.00550	-.00673	-.00807	-.00847	-.00593	-.00293	-.00094
B(2 2)	.05993	.06005	.06190	.06467	.06477	.05853	.05049	.04367
B(2 3)	.00814	.00781	.00845	.00925	.01112	.01398	.01639	.01814
B(2 4)	-.03089	-.03429	-.03723	-.03930	-.04145	-.04320	-.04353	-.04392
B(2 5)	-.00393	-.00345	-.00401	-.00375	-.00416	-.00763	-.01157	-.01456
B(2 6)	-.01401	-.01573	-.01787	-.02017	-.01984	-.01384	-.00743	-.00172
B(3 1)	.00000	.00002	.00002	.00003	.00003	.00002	.00000	-.00001
B(3 2)	-.00026	-.00026	-.00027	-.00029	-.00030	-.00027	-.00023	-.00019
B(3 3)	-.00008	-.00007	-.00007	-.00007	-.00008	-.00009	-.00010	-.00011
B(3 4)	.00016	.00018	.00019	.00020	.00021	.00022	.00022	.00022
B(3 5)	.00002	.00003	.00003	.00003	.00003	.00005	.00007	.00009
B(3 6)	.00007	.00008	.00009	.00010	.00011	.00007	.00004	.00001

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 117

	TIME = 4.000	TIME = 4.100	TIME = 4.200	TIME = 4.300	TIME = 4.400	TIME = 4.500	TIME = 4.600	TIME = 4.700
B(1 1)	3.92383	3.89590	3.88463	3.85942	3.83325	3.82232	3.85749	3.87773
B(1 2)	-1.42375	-1.14154	-.86474	-.60276	-.35993	-.13229	.05203	.24319
B(1 3)	.60848	.57164	.52545	.49661	.47127	.46625	.49809	.49528
B(1 4)	1.57433	1.49624	1.41401	1.29332	1.12305	.92214	.68519	.45984
B(1 5)	.50850	.55877	.59585	.63354	.67760	.69971	.71955	.69507
B(1 6)	-.18413	-.35872	-.53365	-.64359	-.68133	-.70564	-.72156	-.69528
B(2 1)	.00066	.00155	.00180	.00163	.00382	.00761	.00198	.00116
B(2 2)	.03720	.02864	.02074	.01315	.00614	.00032	-.00376	-.00915
B(2 3)	.01963	.02052	.02152	.02194	.02241	.02164	.01861	.01811
B(2 4)	-.04409	-.04196	-.03975	-.03621	-.03119	-.02530	-.01760	-.01148
B(2 5)	-.01738	-.01925	-.02027	-.02176	-.02358	-.02499	-.02564	-.02654
B(2 6)	.00407	.00982	.01444	.01790	.01913	.02031	.02219	.02198
B(3 1)	-.00002	-.00003	-.00003	-.00004	-.00005	-.00005	-.00004	-.00003
B(3 2)	-.00016	-.00011	-.00007	-.00003	.00001	.00004	.00006	.00009
B(3 3)	-.00011	-.00012	-.00012	-.00012	-.00012	-.00011	-.00009	-.00008
B(3 4)	.00022	.00021	.00020	.00018	.00015	.00011	.00007	.00004
B(3 5)	.00011	.00012	.00012	.00013	.00014	.00015	.00017	.00017
B(3 6)	-.00002	-.00005	-.00007	-.00009	-.00010	-.00011	-.00013	-.00013

	TIME = 4.800	TIME = 4.900	TIME = 5.000	TIME = 5.100	TIME = 5.200	TIME = 5.300	TIME = 5.400	TIME = 5.500
B(1 1)	3.86632	3.86344	3.86431	3.84413	3.84714	3.85715	3.88667	3.91348
B(1 2)	.41031	.57201	.70313	.85603	.93500	.97184	1.01644	1.03684
B(1 3)	.48341	.47135	.45677	.44187	.42982	.41668	.42129	.42310
B(1 4)	.27492	.07180	-.02550	-.14725	-.25448	-.30955	-.36244	-.38751
B(1 5)	.79584	.71907	.71292	.72644	.71468	.68400	.62658	.57118
B(1 6)	-.54622	-.58345	-.57695	-.58445	-.54140	-.51434	-.46895	-.44010
B(2 1)	.00148	.00147	.00117	.00119	.00050	-.00019	-.00131	-.00237
B(2 2)	-.01415	-.01387	-.02270	-.02746	-.03032	-.03167	-.03319	-.03377
B(2 3)	.01870	.01346	.01910	.01952	.02007	.02016	.01981	.01940
B(2 4)	-.00516	-.00064	.00159	.00525	.00362	.00996	.01172	.01227
B(2 5)	-.02699	-.02799	-.02909	-.02842	-.02791	-.02679	-.02472	-.02258
B(2 6)	.02037	.01957	.01773	.01732	.01545	.01410	.01208	.01073
B(3 1)	-.00003	-.00003	-.00003	-.00003	-.00002	-.00002	-.00001	-.00000
B(3 2)	.00011	.00014	.00015	.00018	.00019	.00020	.00021	.00021
B(3 3)	-.00008	-.00008	-.00009	-.00009	-.00009	-.00009	-.00009	-.00009
B(3 4)	.00001	-.00002	-.00003	-.00004	-.00006	-.00007	-.00008	-.00008
B(3 5)	.00017	.00017	.00017	.00017	.00017	.00016	.00015	.00014
B(3 6)	-.00012	-.00011	-.00011	-.00010	-.00009	-.00008	-.00007	-.00006

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 117

	TIME = 5.600	TIME = 5.700	TIME = 5.800	TIME = 5.900	TIME = 6.000	TIME = 6.100	TIME = 6.200	TIME = 6.300
B(1 1)	3.92384	3.93677	3.96084	4.00978	4.07617	4.08462	4.17235	4.19558
B(1 2)	1.03198	1.02419	.99634	.91799	.78274	.01029	.49091	.35558
B(1 3)	.41697	.42540	.42108	.39625	.39630	.36538	.48492	.41290
B(1 4)	-.41239	-.42704	-.39570	-.36445	-.32536	-.28348	-.20028	-.10379
B(1 5)	.53323	.47423	.41260	.31595	.23447	-.20605	.11358	.05769
B(1 6)	-.39678	-.33838	-.31275	-.21446	-.11555	.62752	.04593	.07948
B(2 1)	-.00285	-.00348	-.00437	-.00583	-.00814	-.02264	-.01129	-.01197
B(2 2)	-.03365	-.03339	-.03228	-.03064	-.02605	.00012	-.01543	-.01244
B(2 3)	.01935	.01921	.01955	.02096	.02095	.02210	.02022	.01959
B(2 4)	.01289	.01293	.01169	.01015	.00920	.00792	.00589	.00340
B(2 5)	-.02117	-.01907	-.01582	-.01297	-.01010	.00511	-.00592	-.00447
B(2 6)	.00881	.00706	.00591	.00201	-.00170	-.02727	-.00741	-.00847
B(3 1)	.00000	.00001	.00001	.00003	.00004	.00015	.00036	.00007
B(3 2)	.00020	.00020	.00019	.00017	.00014	-.00005	.00008	.00005
B(3 3)	-.00009	-.00009	-.00009	-.00010	-.00011	-.00011	-.00010	-.00010
B(3 4)	-.00008	-.00008	-.00007	-.00005	-.00005	-.00005	-.00004	-.00002
B(3 5)	.00013	.00012	.00010	.00008	.00006	-.00005	.00004	.00003
B(3 6)	-.00005	-.00003	-.00003	-.00000	.00003	.00021	.00006	.00007

	TIME = 6.400	TIME = 6.500	TIME = 6.600	TIME = 6.700	TIME = 6.800	TIME = 6.900	TIME = 7.000	TIME = 7.100
B(1 1)	4.23484	4.22510	4.19319	4.18801	4.19594	4.17710	4.16592	4.15355
B(1 2)	.22306	.18233	.16827	.14750	.10246	.06094	.05071	.05315
B(1 3)	.41680	.41404	.41015	.40737	.40552	.41623	.42165	.42773
B(1 4)	-.00462	.07086	.14325	.21909	.34228	.46849	.58515	.66287
B(1 5)	.00998	.00329	.01803	.00979	-.01199	-.01549	-.01972	-.03407
B(1 6)	.10626	.06341	-.00379	-.05680	-.12683	-.20337	-.30297	-.37412
B(2 1)	-.01318	-.01309	-.01241	-.01253	-.01286	-.01236	-.01204	-.01193
B(2 2)	-.00851	-.00737	-.00661	-.00555	-.00374	-.00219	-.00158	-.00147
B(2 3)	.01910	.01890	.01865	.01844	.01808	.01709	.01622	.01557
B(2 4)	.00074	-.00132	-.00315	-.00507	-.00827	-.01179	-.01497	-.01725
B(2 5)	-.00263	-.00238	-.00277	-.00247	-.00183	-.00176	-.00164	-.00131
B(2 6)	-.00916	-.00774	-.00575	-.00406	-.00199	.00023	.00309	.00524
B(3 1)	.00008	.00009	.00007	.00007	.00008	.00007	.00007	.00007
B(3 2)	.00003	.00002	.00002	.00001	-.00000	-.00001	-.00001	-.00001
B(3 3)	-.00010	-.00010	-.00010	-.00010	-.00010	-.00009	-.00009	-.00008
B(3 4)	-.00000	.00001	.00002	.00003	.00005	.00007	.00009	.00010
B(3 5)	.00002	.00002	.00002	.00002	.00001	.00001	.00001	.00001
B(3 6)	.00007	.00005	.00005	.00004	.00002	.00001	-.00001	-.00002

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 117

	TIME = 7.200	TIME = 7.300	TIME = 7.400	TIME = 7.500	TIME = 7.600	TIME = 7.700	TIME = 7.800	TIME = 7.900
B(1 1)	4.16319	4.14387	4.13947	4.13711	4.14531	4.13948	4.13022	4.11204
B(1 2)	.05935	.06349	.08155	.09781	.12695	.19558	.26546	.30955
B(1 3)	.43339	.45323	.47036	.47380	.47162	.47212	.47705	.48846
B(1 4)	.71776	.77492	.80701	.81231	.81185	.75843	.72207	.73800
B(1 5)	-.05103	-.07650	-.09980	-.11397	-.13857	-.14873	-.14556	-.12896
B(1 6)	-.42340	-.47375	-.51639	-.53170	-.54904	-.54145	-.54813	-.55470
B(2 1)	-.01185	-.01145	-.01117	-.01119	-.01126	-.01081	-.01025	-.00937
B(2 2)	-.00139	-.00144	-.00163	-.00200	-.00267	-.00420	-.00559	-.00631
B(2 3)	.01493	.01429	.01373	.01350	.01309	.01246	.01200	.01120
B(2 4)	-.01878	-.02068	-.02158	-.02161	-.02163	-.02019	-.01911	-.01841
B(2 5)	-.00083	.00011	.00094	.00155	.00246	.00239	.00301	.00252
B(2 6)	.00671	.00845	.00964	.01010	.01040	.01003	.00994	.00951
B(3 1)	.00007	.00007	.00007	.00007	.00007	.00007	.00006	.00006
B(3 2)	-.00001	-.00001	-.00001	-.00001	-.00001	.00000	.00001	.00001
B(3 3)	-.00008	-.00009	-.00007	-.00007	-.00007	-.00007	-.00007	-.00006
B(3 4)	.00011	.00013	.00013	.00013	.00013	.00012	.00011	.00010
B(3 5)	.00001	.00000	-.00000	-.00001	-.00001	-.00001	-.00002	-.00001
B(3 6)	-.00003	-.00004	-.00005	-.00005	-.00005	-.00005	-.00005	-.00004

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 118

	TIME = .200	TIME = .600	TIME = .450	TIME = 1.000	TIME = 1.150	TIME = 1.750	TIME = 2.350	TIME = 2.950
B(1 1)	2.47259	16.65273	6.47755	5.27470	3.48254	2.82486	1.94849	2.40712
B(1 2)	3.33407	-10.67267	-.93033	-.38045	1.47038	-.50863	.11828	-.90363
B(1 3)	I	-.09567	-.02290	-.01794	-.05889	.67209	.71956	.64619
B(1 4)	I	.08967	.01617	.01116	-.07453	.31963	-.63858	.03155
B(1 5)	I	I	I	I	.11579	.01534	.90465	.36656
B(1 6)	I	I	I	I	-.04723	.01581	.01683	.37025
B(2 1)	I	I	I	I	.00057	.00423	.01674	.00519
B(2 2)	I	I	I	I	-.00092	-.02096	-.00924	.03375
B(2 3)	I	I	I	I	.00038	-.00015	.01253	-.00254
B(2 4)	I	I	I	I	I	.00004	-.02246	-.00194
B(2 5)	I	I	I	I	I	-.00011	-.00011	-.00858
B(2 6)	I	I	I	I	I	.00017	-.00004	-.00925
B(3 1)	I	I	I	I	I	I	.00001	-.00004
B(3 2)	I	I	I	I	I	I	-.00004	-.00015
B(3 3)	I	I	I	I	I	I	.00011	-.00001
B(3 4)	I	I	I	I	I	I	I	.00002
B(3 5)	I	I	I	I	I	I	I	.00004
B(3 6)	I	I	I	I	I	I	I	.00005

	TIME = 3.050	TIME = 3.150	TIME = 3.250	TIME = 3.350	TIME = 3.450	TIME = 3.550	TIME = 3.650	TIME = 3.750
B(1 1)	2.49153	2.53366	2.54386	2.57441	2.60269	2.63552	2.69675	2.69366
B(1 2)	-1.05634	-1.13726	-1.17734	-1. 2751	-1.28601	-1.33189	-1.42316	-1.44341
B(1 3)	.51392	.50092	.57746	.56386	.54920	.53955	.52255	.50947
B(1 4)	.26451	.38161	.45427	.49734	.53102	.53713	.51583	.45006
B(1 5)	.25155	.20603	.17122	.14099	.11150	.08334	.04112	.06653
B(1 6)	.33410	.30348	.31603	.35965	.42834	.52360	.69306	.81677
B(2 1)	.00373	.00257	.00221	.00131	.00029	-.00062	-.00282	-.00353
B(2 2)	.03570	.03693	.03696	.03759	.03826	.03806	.04071	.04118
B(2 3)	-.00167	-.00155	-.00074	-.00043	-.00004	.00086	.00124	.00057
B(2 4)	-.00670	-.00902	-.01094	-.01196	-.01301	-.01442	-.01457	-.01253
B(2 5)	-.00575	-.00460	-.00330	-.00241	-.00164	-.00040	.00052	-.00136
B(2 6)	-.00896	-.00819	-.00876	-.01008	-.01208	-.01546	-.02106	-.02490
B(3 1)	-.00003	-.00003	-.00003	-.00002	-.00002	-.00001	.00000	.00001
B(3 2)	-.00016	-.00017	-.00017	-.00017	-.00018	-.00019	-.00019	-.00020
B(3 3)	-.00001	-.00001	-.00001	-.00001	-.00001	-.00002	-.00002	-.00001
B(3 4)	.00004	.00005	.00006	.00006	.00006	.00007	.00007	.00006
B(3 5)	.00003	.00003	.00002	.00002	.00001	.00001	-.00000	.00001
B(3 6)	.00005	.00004	.00004	.00005	.00006	.00008	.00012	.00014

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

PASADON TEST NO. 118

	TIME = 3.850	TIME = 3.950	TIME = 4.050	TIME = 4.150	TIME = 4.250	TIME = 4.350	TIME 4.450	TIME = 4.550
B(1 1)	2.58993	2.54209	2.53612	2.53148	2.45540	2.30403	2.38552	2.39137
B(1 2)	-1.41187	-1.28587	-1.13190	-.93999	-.69653	-.45093	-.29110	-.16258
B(1 3)	.49016	.45474	.41794	.38511	.35265	.33904	.34334	.33952
B(1 4)	.39898	.38504	.39995	.40044	.36538	.29838	.20734	.14652
B(1 5)	.09501	.15473	.22908	.29545	.38694	.45820	.49059	.49907
B(1 6)	.86762	.78199	.63939	.45566	.27274	.11275	.01431	-.05528
B(2 1)	-.00354	-.00249	-.00078	.00090	.00328	.00507	.00504	.00482
B(2 2)	.04012	.03598	.03092	.02502	.01777	.01080	.00628	.00284
B(2 3)	.00079	.00200	.00379	.00502	.00595	.00608	.00507	.00471
B(2 4)	-.01126	-.01140	-.01251	-.01296	-.01205	-.01000	-.00675	-.00465
B(2 5)	-.00265	-.00455	-.00657	-.00942	-.01115	-.01350	-.01504	-.01571
B(2 6)	-.02523	-.02267	-.01826	-.01310	-.00725	-.00211	.00145	.00376
B(3 1)	.00001	-.00009	-.00001	-.00002	-.00004	-.00005	-.00005	-.00004
B(3 2)	-.00020	-.00018	-.00015	-.00012	-.00008	-.00004	-.00001	.00001
B(3 3)	-.00001	-.00001	-.00002	-.00003	-.00003	-.00003	-.00002	-.00002
B(3 4)	.00005	.00005	.00005	.00005	.00006	.00005	.00003	.00001
B(3 5)	.00002	.00003	.00004	.00005	.00007	.00008	.00009	.00010
B(3 6)	.00015	.00013	.00011	.00008	.00005	.00001	-.00001	-.00003

	TIME = 4.650	TIME = 4.750	TIME = 4.850	TIME = 4.950	TIME = 5.050	TIME = 5.150	TIME = 5.250	TIME = 5.350
B(1 1)	2.40794	2.42365	2.43134	2.43584	2.40728	2.37534	2.37111	2.39298
B(1 2)	-.06607	.04362	.16344	.27330	.39619	.50239	.55796	.59138
. 3)	.33257	.32979	.31620	.30714	.23396	.28692	.28024	.27895
B(1 4)	.08977	.02615	-.02960	-.08651	-.18679	-.29357	-.35359	-.41322
B(1 5)	.47566	.45512	.44389	.42872	.45303	.47557	.47383	.44379
B(1 6)	-.07957	-.11008	-.15044	-.18979	-.19893	-.17941	-.14607	-.11437
B(2 1)	.00433	.00384	.00367	.00359	.00451	.00546	.00556	.00484
B(2 2)	.00021	-.00286	-.00527	-.00953	-.01372	-.01635	-.01789	-.01891
B(2 3)	.00472	.00459	.00479	.00497	.00519	.00528	.00548	.00560
B(2 4)	-.00302	-.00122	.00045	.00211	.00512	.00833	.01046	.01193
B(2 5)	-.01512	-.01464	-.01443	-.01422	-.01515	-.01590	-.01587	-.01496
B(2 6)	.00436	.00518	.00607	.00697	.00791	.00621	.00494	.00387
B(3 1)	-.00004	-.00004	-.00004	-.00004	-.00004	-.00005	-.00005	-.00004
B(3 2)	.00002	.00003	.00005	.00007	.00009	.00010	.00011	.00012
B(3 3)	-.00002	-.00002	-.00002	-.00002	-.00002	-.00002	-.00002	-.00002
B(3 4)	.00001	-.00000	-.00001	-.00002	-.00003	-.00005	-.00006	-.00007
B(3 5)	.00009	.00009	.00009	.00008	.00009	.00009	.00009	.00009
B(3 6)	-.00003	-.00003	-.00004	-.00005	-.00005	-.00004	-.00003	-.00003

TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASACON TEST NO. 119

	TIME = 5.450	TIME = 5.550	TIME = 5.650	TIME = 5.750	TIME = 5.850	TIME = 5.950	TIME = 6.050	TIME = 6.150
B(1 1)	2.39415	2.40252	2.38903	2.39584	2.42452	2.47336	2.51776	2.56101
B(1 2)	.61976	.62564	.63050	.63426	.62044	.57392	.52239	.47514
B(1 3)	.26623	.25626	.24841	.24116	.24198	.23251	.21516	.21107
B(1 4)	-.48275	-.55593	-.63910	-.67603	-.65765	-.57756	-.49766	-.42587
B(1 5)	.43762	.42712	.42747	.41885	.39795	.31346	.25233	.21059
B(1 6)	-.05675	.01916	.10973	.14950	.15263	.13983	.14274	.15551
B(2 1)	.00452	.00393	.00373	.00301	.00192	.00051	-.00060	-.00157
B(2 2)	-.01963	-.01989	-.01996	-.02000	-.01974	-.01857	-.01732	-.01471
B(2 3)	.00604	.00644	.00593	.00723	.00720	.00750	.00819	.00927
B(2 4)	.01363	.01541	.01590	.01741	.01673	.01453	.01199	.00993
B(2 5)	-.01452	-.01399	-.01354	-.01282	-.01150	-.00937	-.00725	-.00600
B(2 6)	.00213	.00014	-.00199	-.00292	-.00712	-.00330	-.00395	-.00473
B(3 1)	-.00004	-.00004	-.00003	-.00003	-.00002	-.00001	-.00000	.00001
B(3 2)	.00012	.00012	.00012	.00012	.00012	.00011	.00010	.00009
B(3 3)	-.00003	-.00003	-.00003	-.00004	-.00004	-.00004	-.00004	-.00004
B(3 4)	-.00008	-.00009	-.00010	-.00010	-.00010	-.00008	-.00007	-.00005
B(3 5)	.00009	.00006	.00008	.00008	.00007	.00006	.00004	.00003
B(3 6)	-.00001	-.00000	.00001	.00002	.00002	.00002	.00002	.00003

	TIME = 6.250	TIME = 6.350	TIME = 6.450	TIME = 6.550	TIME = 6.650	TIME = 6.750	TIME = 6.850	TIME = 6.950
B(1 1)	2.58769	2.61067	2.62550	2.62491	2.63186	2.63859	2.64630	2.65216
B(1 2)	.34129	.27807	.23917	.20131	.17339	.14057	.12815	.11259
B(1 3)	.21254	.20890	.20832	.20912	.20035	.19642	.19610	.19254
B(1 4)	-.34275	-.24237	-.16417	-.09337	-.02343	.07534	.07779	.11259
B(1 5)	.17844	.15930	.14892	.14560	.14092	.13288	.12423	.10991
B(1 6)	.16643	.12761	.07530	.03787	.00137	-.02200	-.04892	-.06117
B(2 1)	-.00257	-.00317	-.00344	-.00733	-.00345	-.00359	-.00387	-.00401
B(2 2)	-.01197	-.01007	-.00907	-.00807	-.00742	-.00655	-.00611	-.00571
B(2 3)	.00814	.00796	.00769	.00743	.00740	.00742	.00725	.00715
B(2 4)	.00759	.00478	.00276	.00184	-.00055	-.00198	-.00313	-.00405
B(2 5)	-.00523	-.00481	-.00469	-.00469	-.00452	-.00429	-.00387	-.00342
B(2 6)	-.00522	-.00412	-.00747	-.00136	-.00032	.00037	.00122	.00168
B(3 1)	.00001	.00002	.00002	.00002	.00002	.00002	.00002	.00002
B(3 2)	.00006	.00005	.00004	.00004	.00003	.00007	.00003	.00002
B(3 3)	-.00004	-.00004	-.00004	-.00004	-.00004	-.00004	-.00004	-.00004
B(3 4)	-.00004	-.00002	-.00001	.00000	.00001	.00002	.00002	.00003
B(3 5)	.00003	.00003	.00003	.00003	.00003	.00002	.00002	.00002
B(3 6)	.00003	.00003	.00002	.00001	.00000	-.00000	-.00001	-.00001

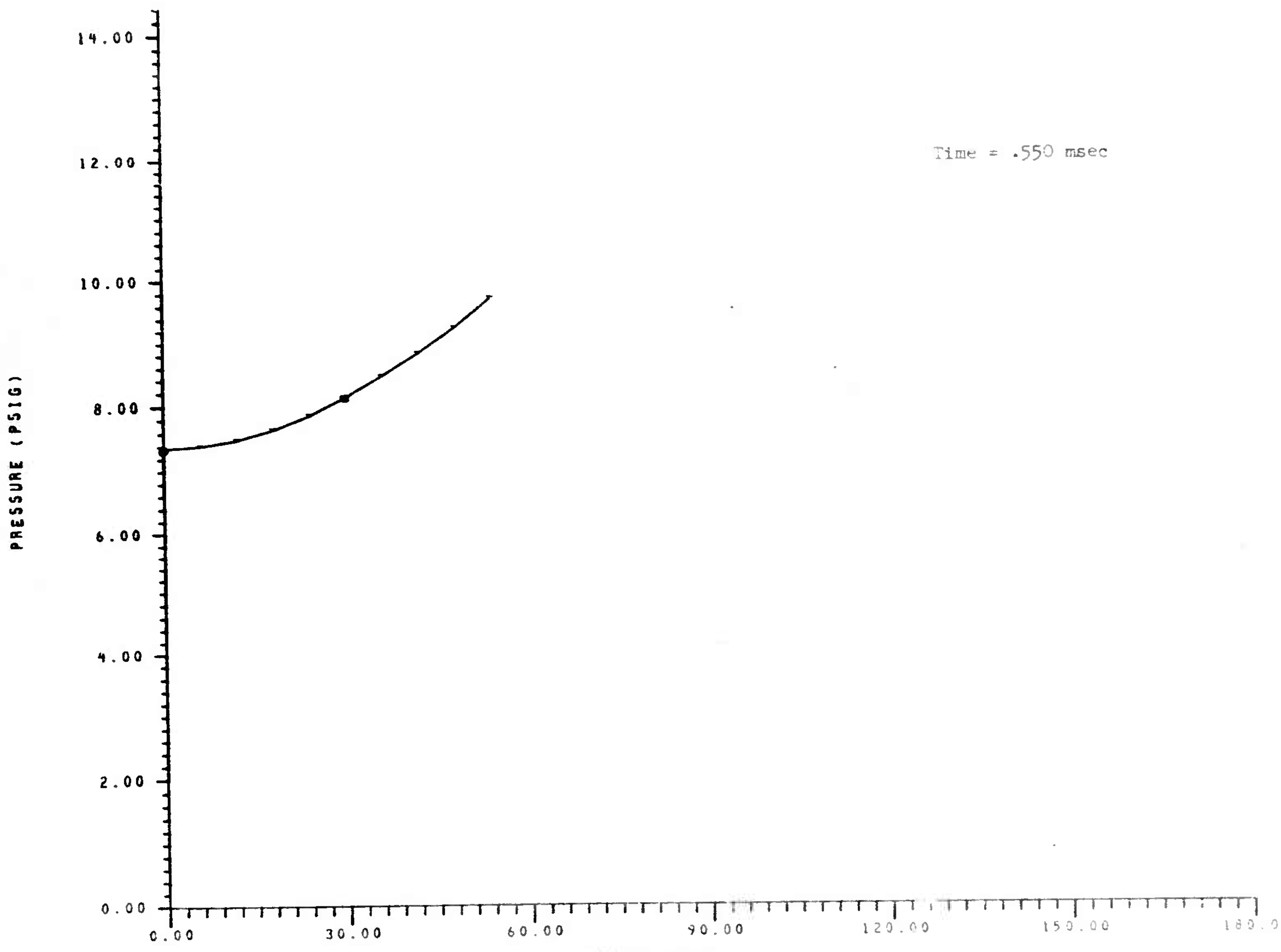
TABLE OF COEFFICIENTS FOR EMPIRICAL EQUATION P(S,THETA)

DASAGON TEST NO. 118

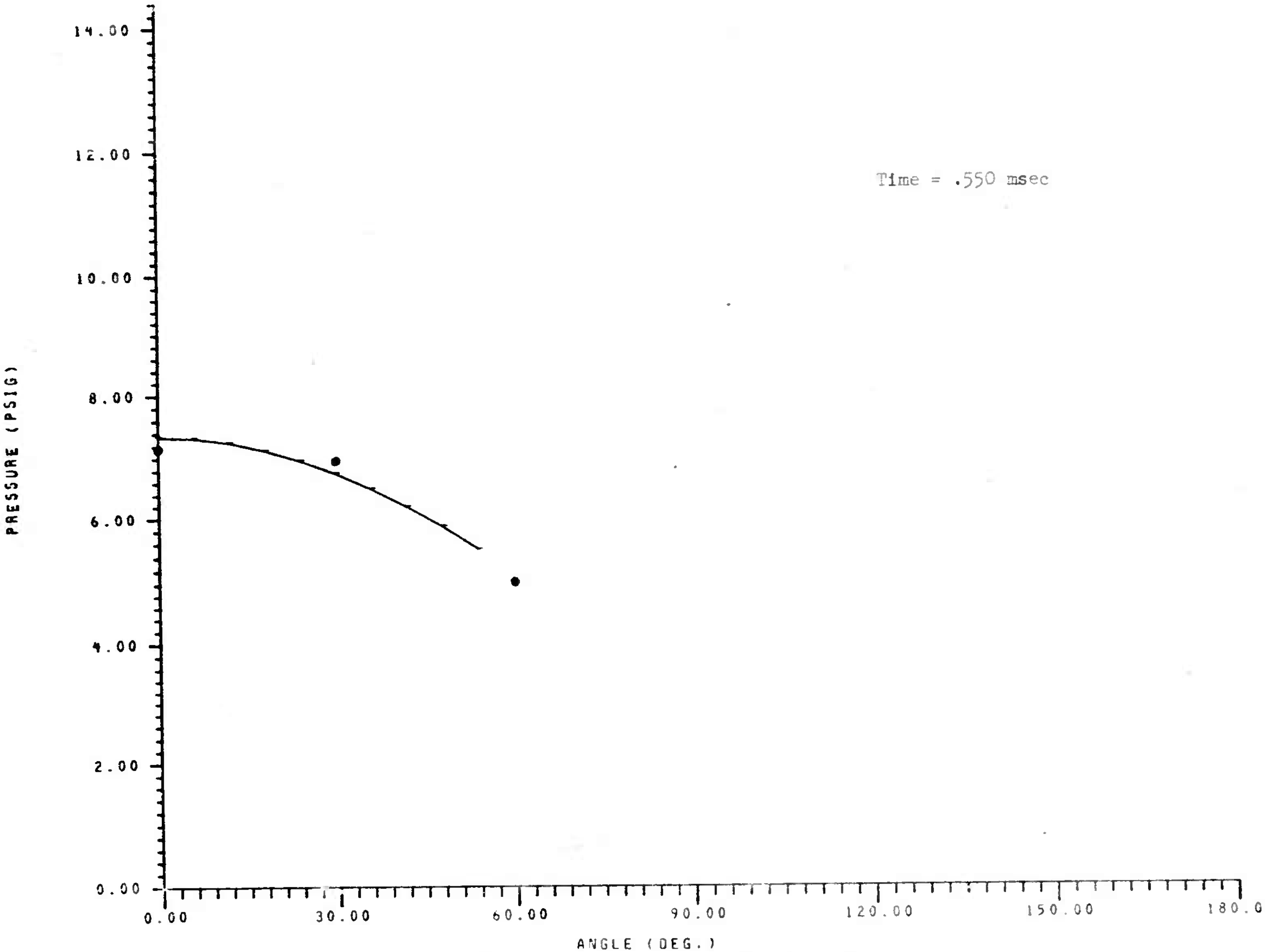
	TIME = 7.050	TIME = 7.150	TIME = 7.250	TIME = 7.350	TIME = 7.450	TIME = 7.550	TIME = 7.650	TIME = 7.750
B(1 1)	2.64949	2.62569	2.61125	2.60299	2.59481	2.59159	2.59726	2.59823
B(1 2)	.09461	.08560	.07025	.05672	.02460	-.00021	-.02830	-.04259
B(1 3)	.18246	.16890	.15787	.15193	.14753	.14394	.14166	.14137
B(1 4)	.13318	.13560	.15081	.15247	.16545	.17697	.19597	.20056
B(1 5)	.09720	.10040	.09098	.08046	.07993	.05576	.04743	.03321
B(1 6)	-.05631	-.04569	-.03590	-.01795	.01089	.04279	.05946	.07810
B(2 1)	-.00394	-.00340	-.00306	-.00287	-.00270	-.00259	-.00272	-.00271
B(2 2)	-.00526	-.00500	-.00449	-.00406	-.00306	-.00226	-.00131	-.00076
B(2 3)	.00725	.00744	.00759	.00763	.00771	.00778	.00779	.00774
B(2 4)	-.00462	-.00470	-.00501	-.00493	-.00537	-.00566	-.00623	-.00634
B(2 5)	-.00291	-.00283	-.00246	-.00299	-.00193	-.00152	-.00096	-.00057
B(2 6)	.00166	.00134	.00097	.00044	-.00041	-.00144	-.00204	-.00273
B(3 1)	.00002	.00002	.00002	.00002	.00001	.00001	.00002	.00002
B(3 2)	.00002	.00002	.00002	.00002	.00001	.00001	.00000	-.00000
B(3 3)	-.00004	-.00004	-.00004	-.00004	-.00004	-.00005	-.00005	-.00004
B(3 4)	.00003	.00003	.00003	.00003	.00003	.00003	.00004	.00004
B(3 5)	.00002	.00002	.00001	.00001	.00001	.00001	.00000	.00000
B(3 6)	-.00001	-.00001	-.00001	-.00000	.00000	.00001	.00001	.00002

APPENDIX D

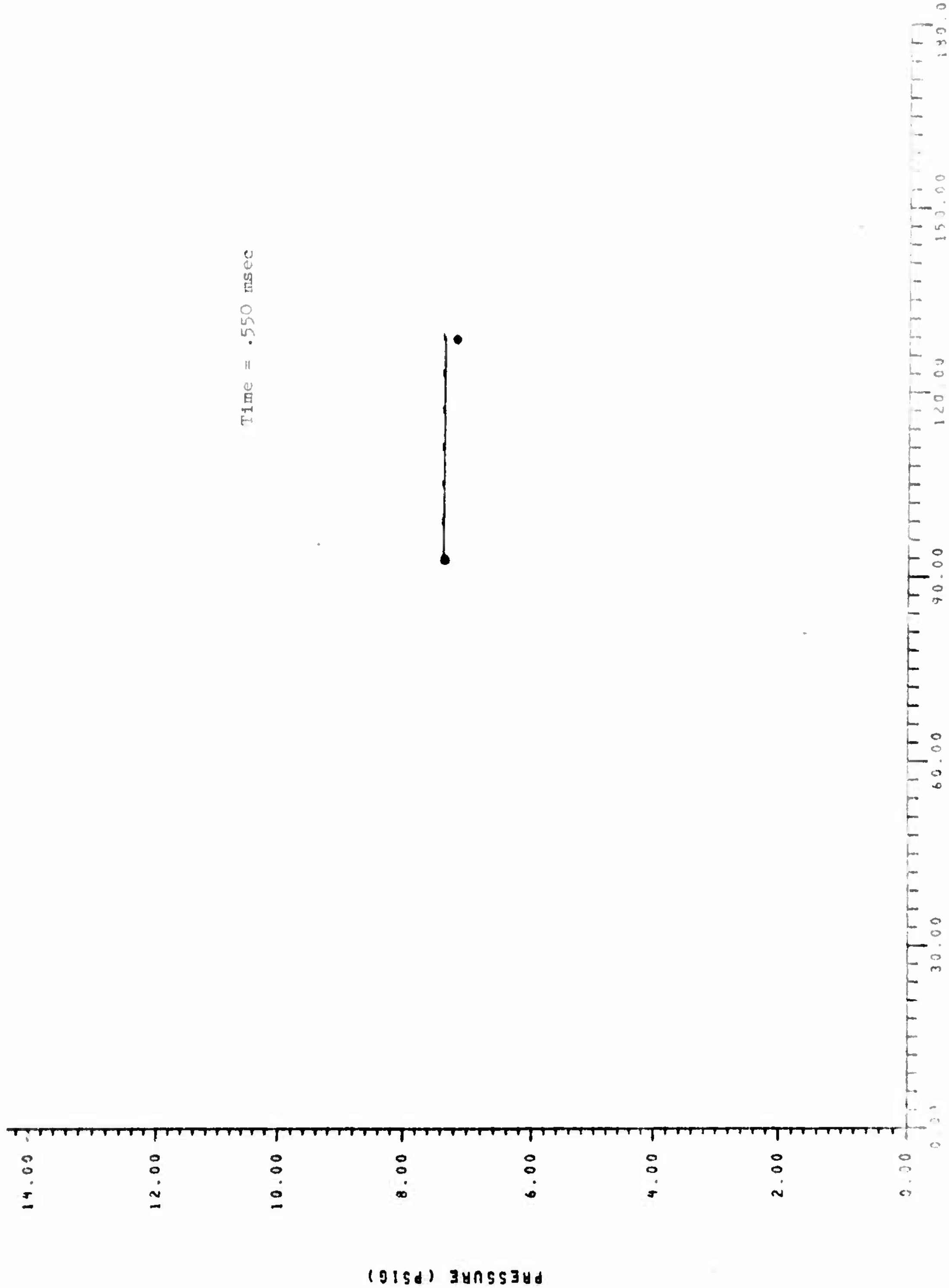
COMPARISONS OF CURVE FITS WITH EXPERIMENTAL DATA



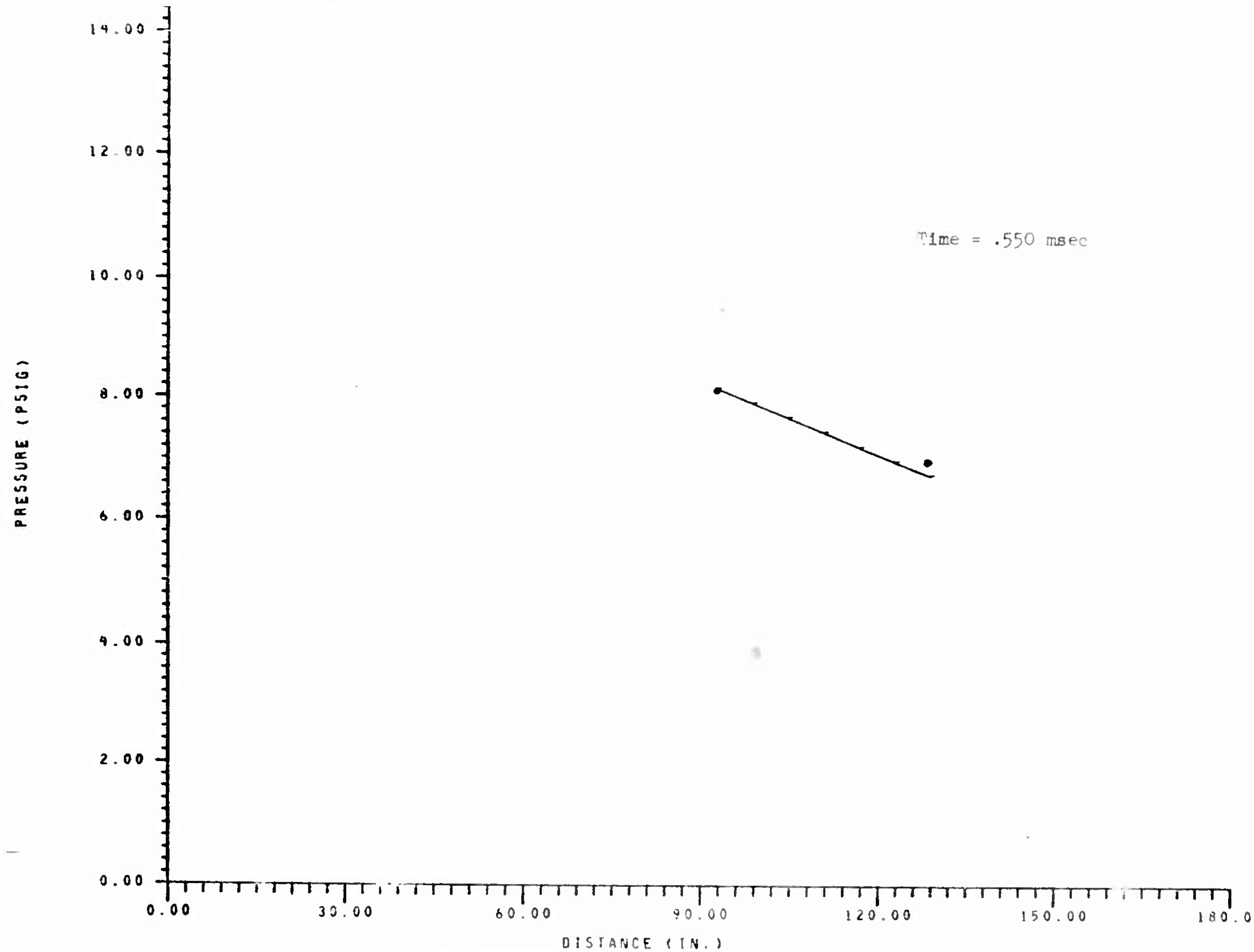
PRESSURE VS ANGLE OF STATION 3 - TEST 114



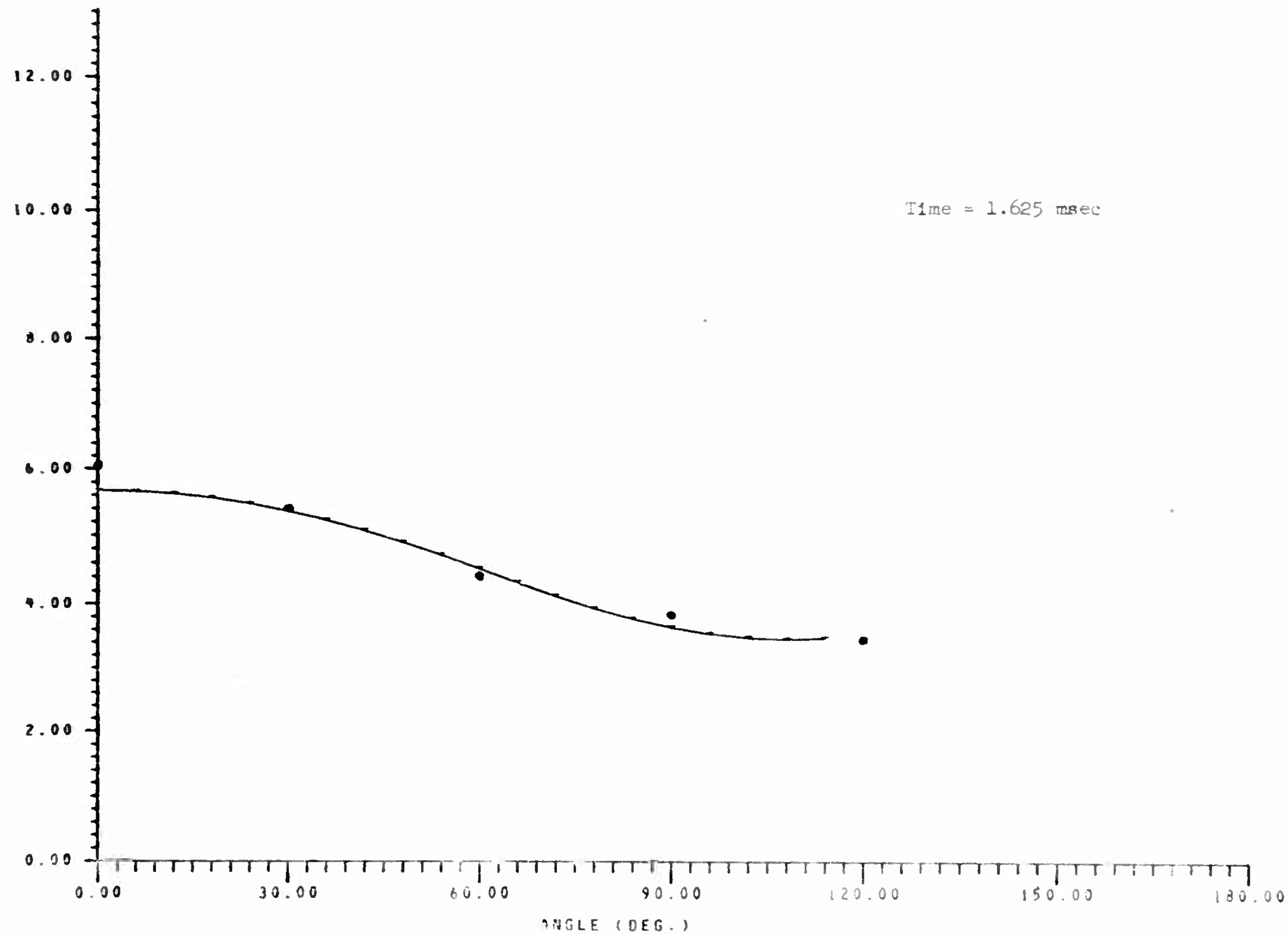
PRESSURE VS ANGLE AT STATION 4 - TEST 114



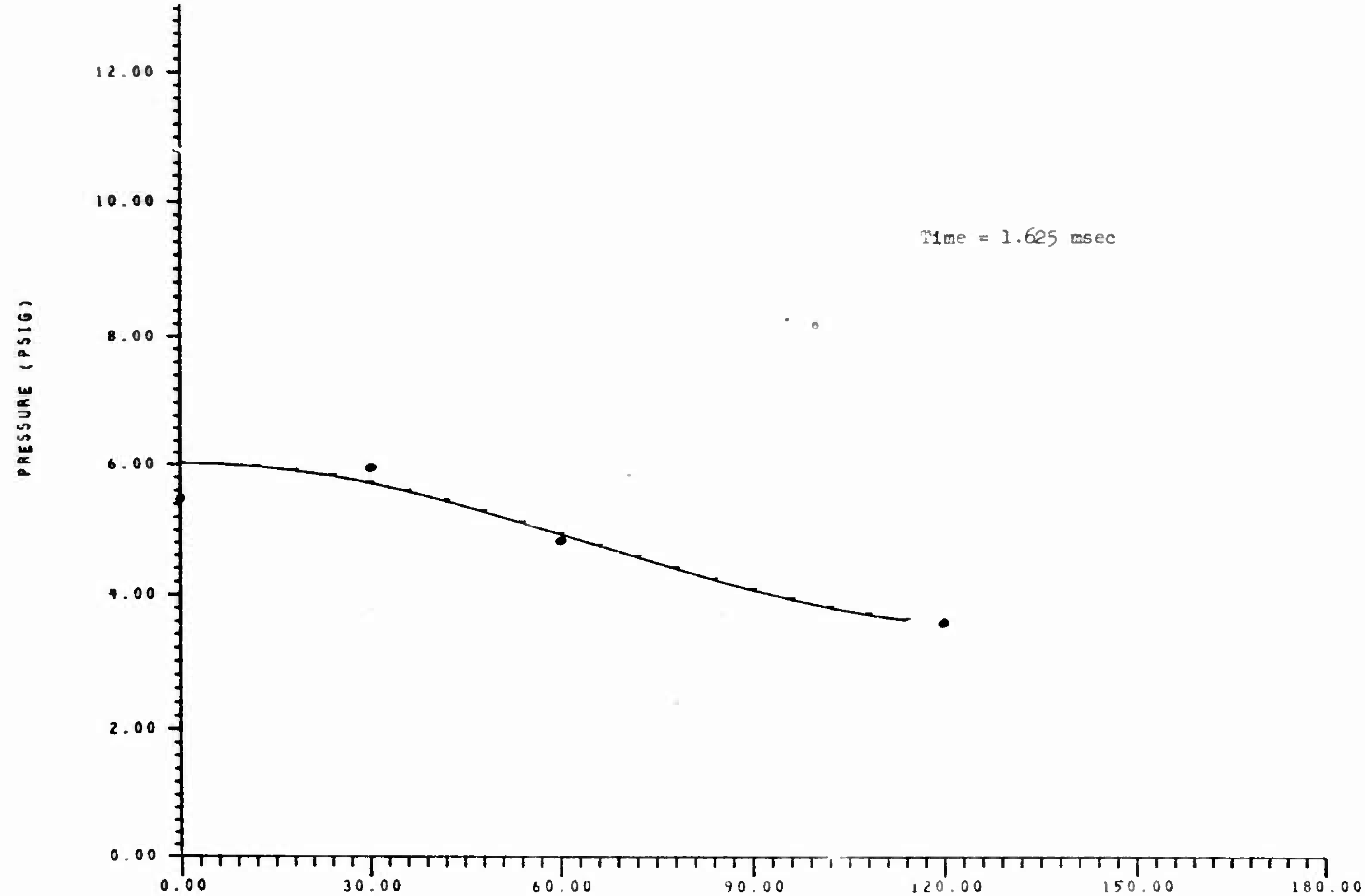
PRESSURE VS DISTANCE AT 0° - TEST 1[illegible]



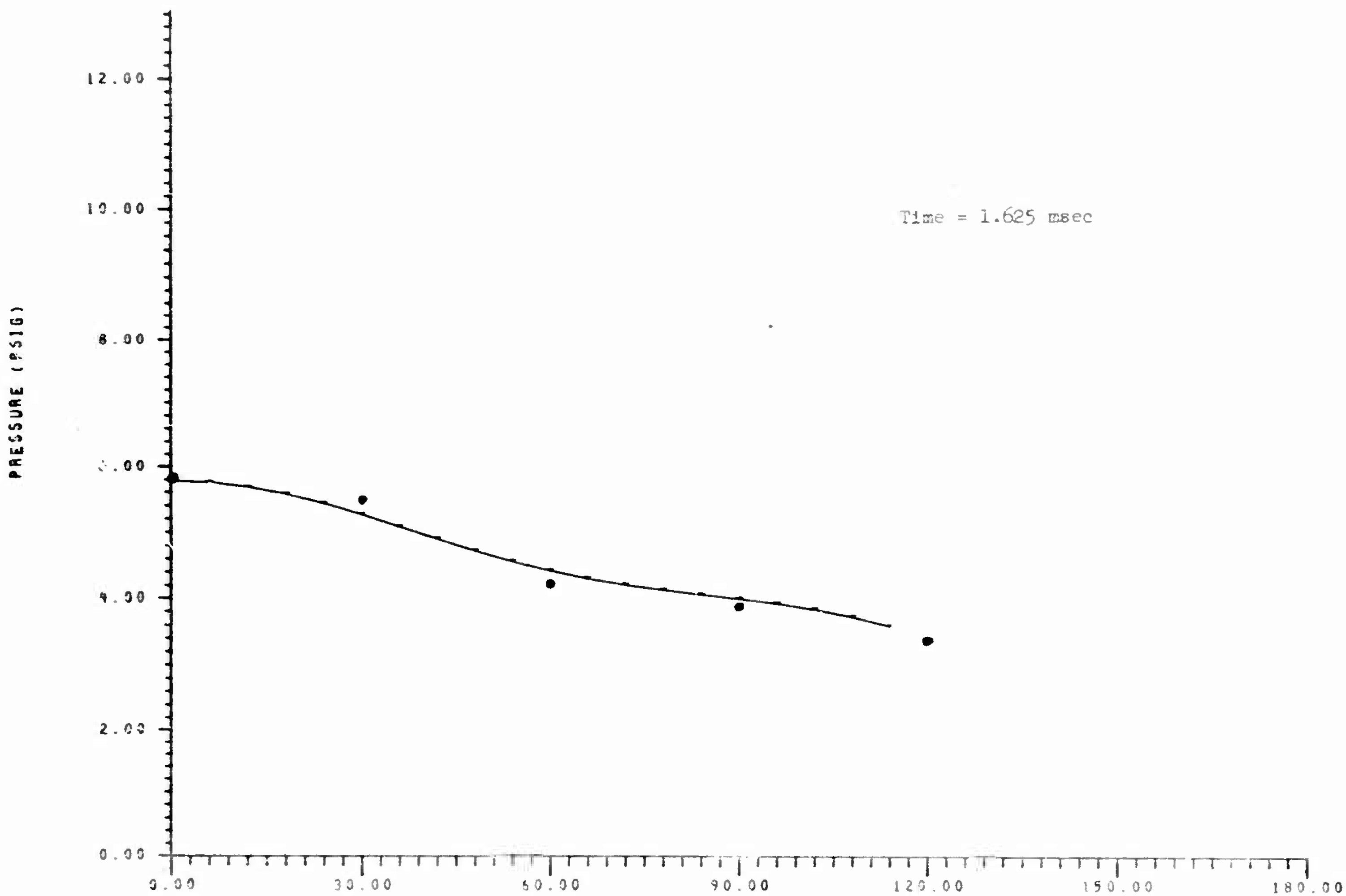
PRESSURE VS DISTANCE AT 30° - TEST 114



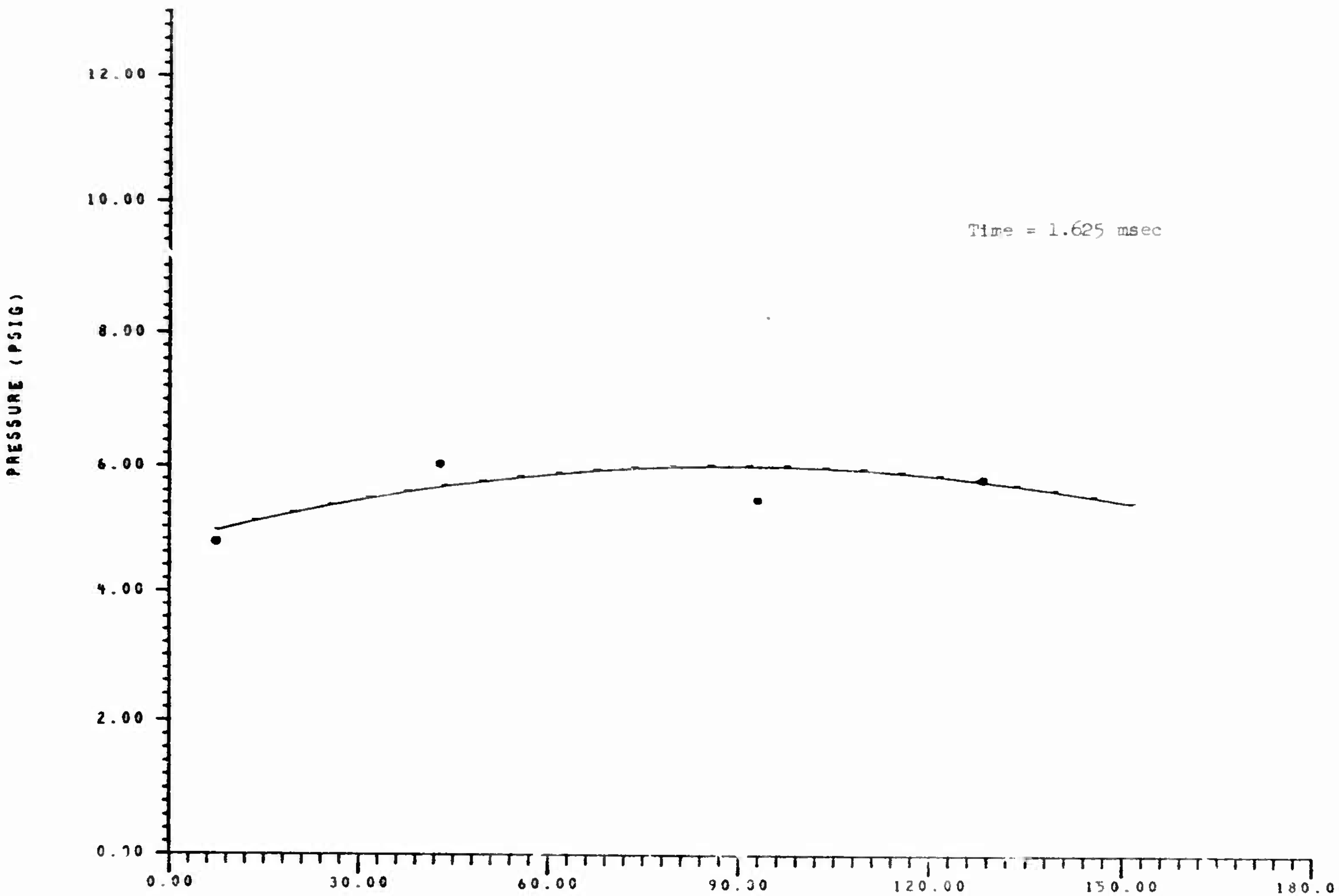
PRESSURE VS ANGLE AT STATION 2 - TEST 114



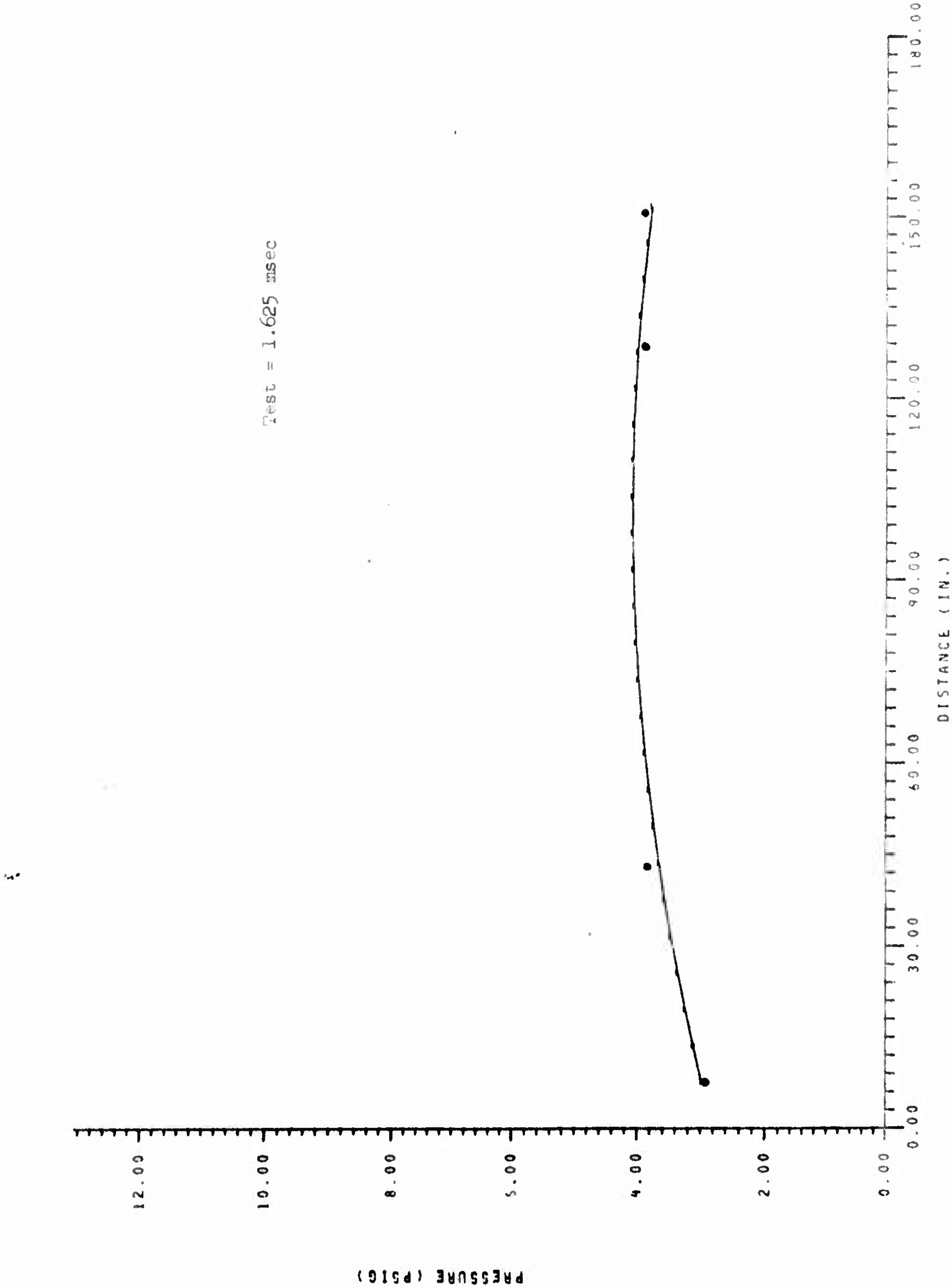
PRESSURE VS ANGLE AT STATION - TEST 114



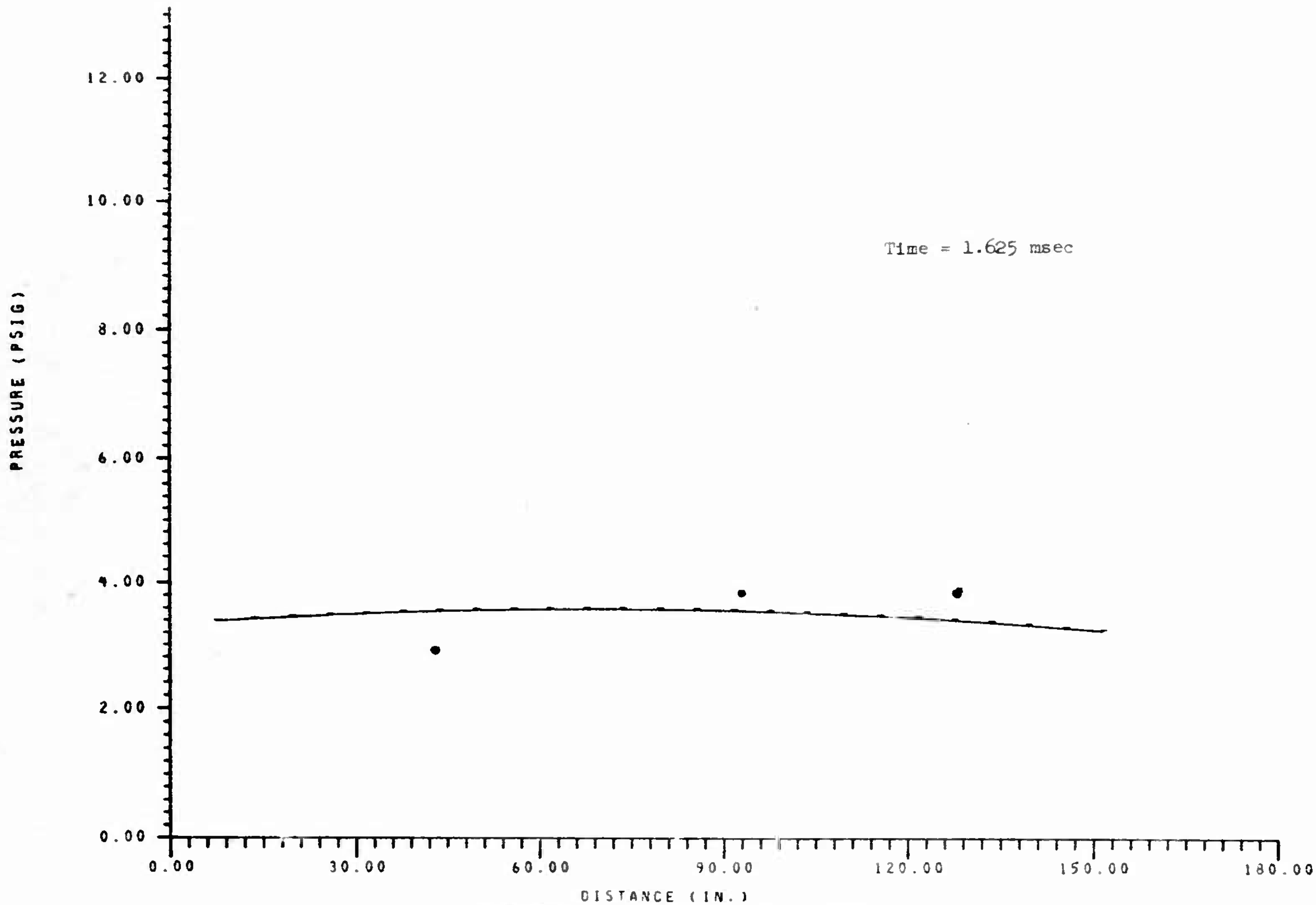
PRESSURE VS ANGLE AT STATION 4 - TEST 114



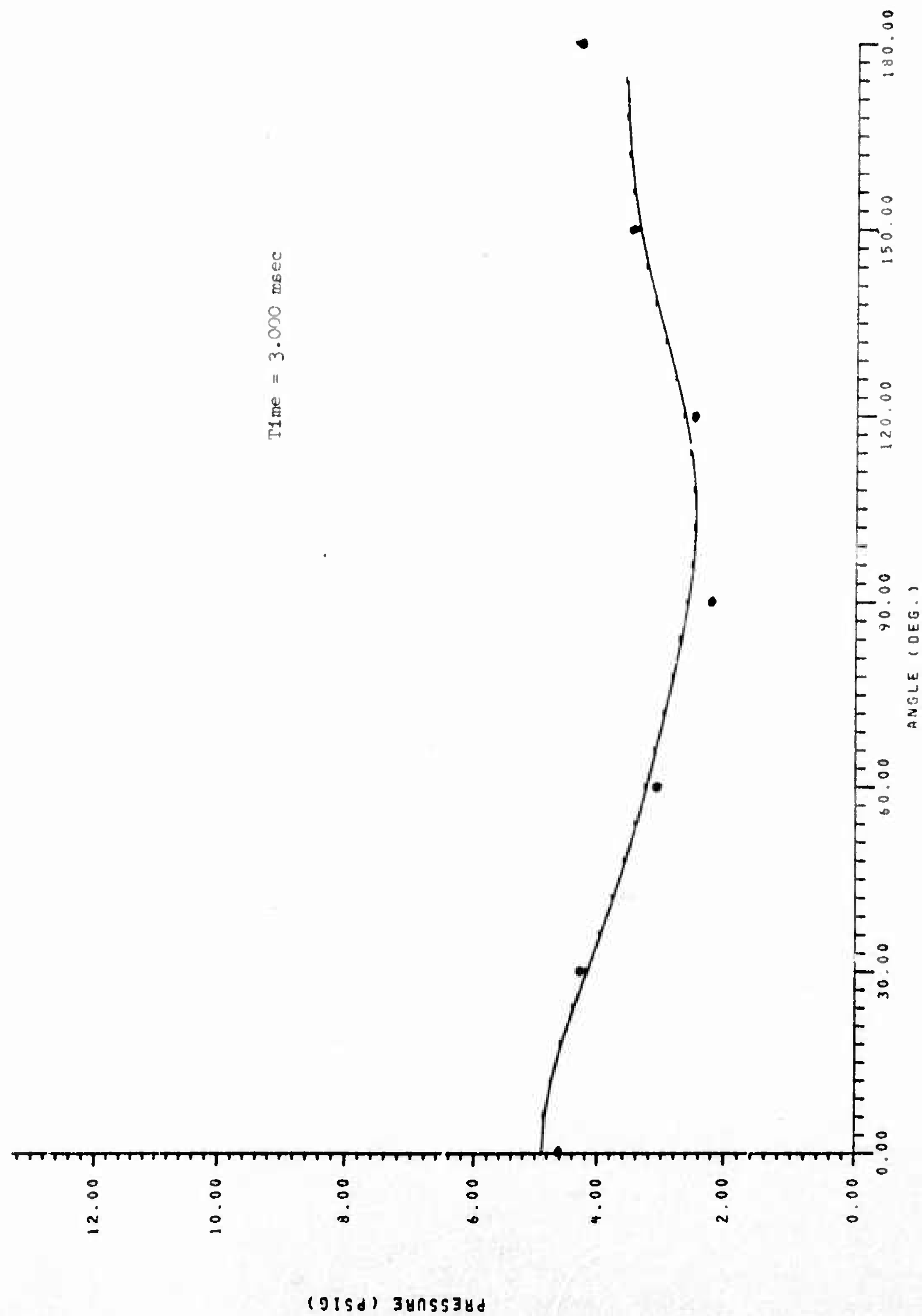
PRESSURE VS DISTANCE AT 0° - TEST 114



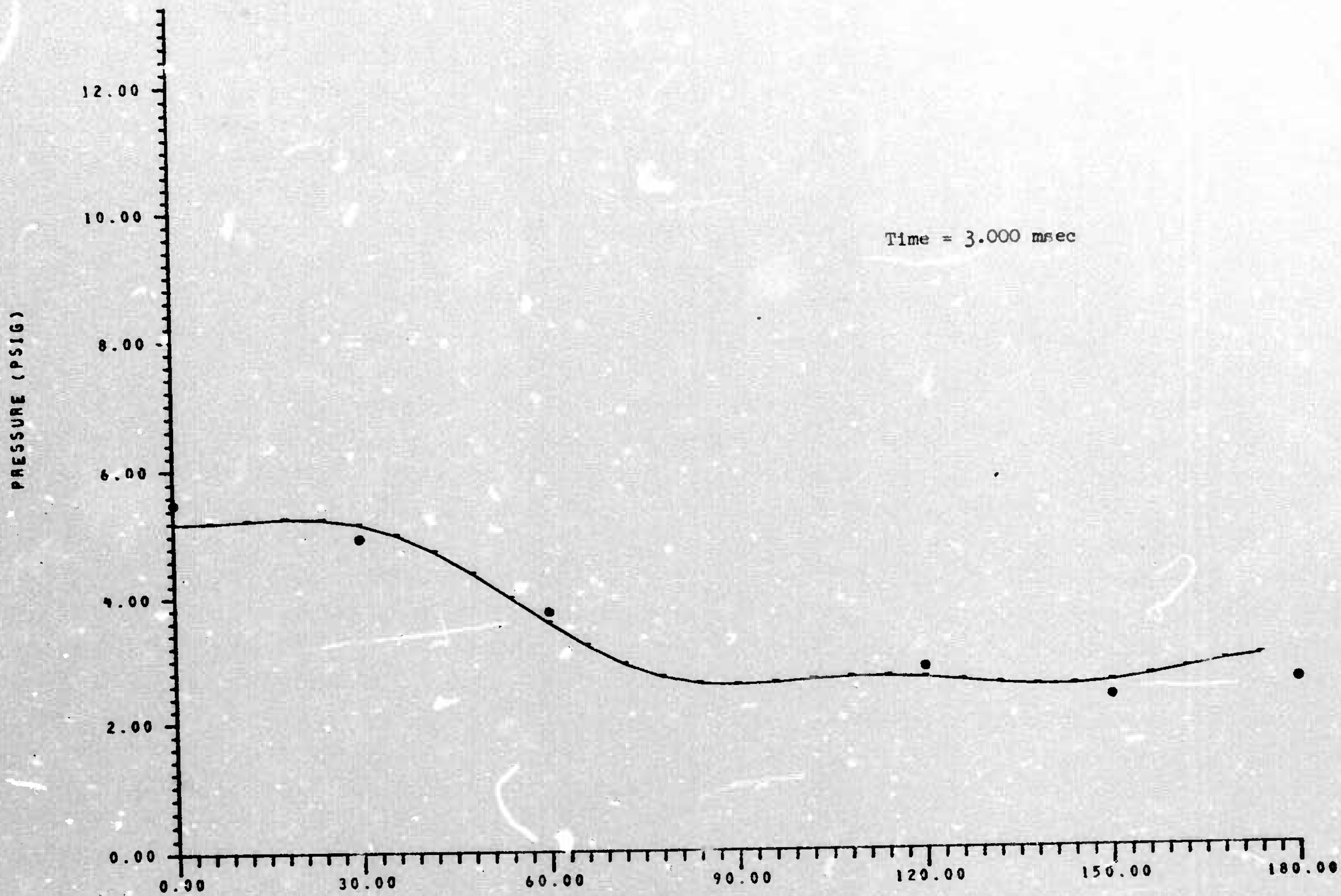
PRESSURE VS DISTANCE AT 90° - TEST 114



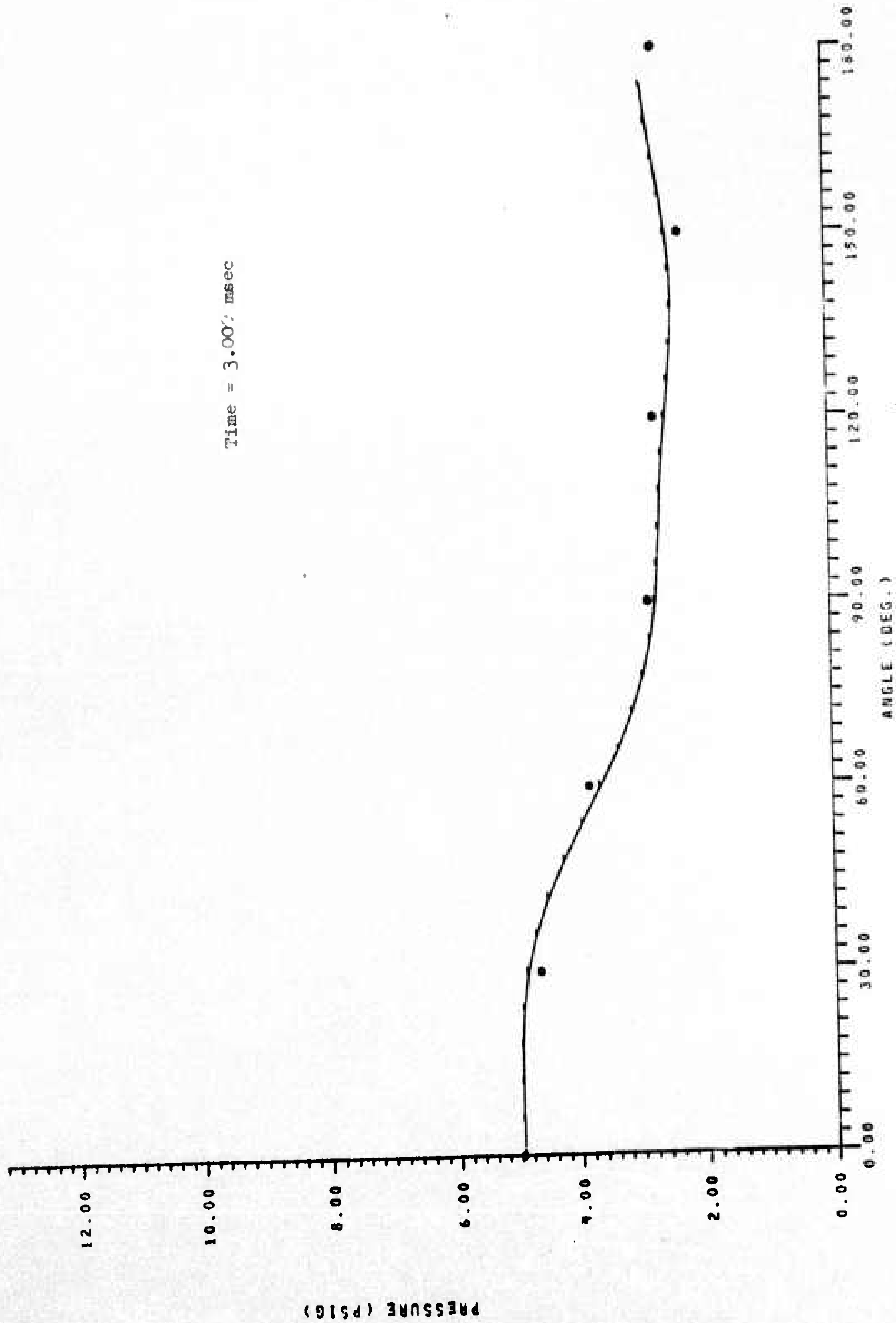
PRESSURE VS DISTANCE AT 120° - TEST 114



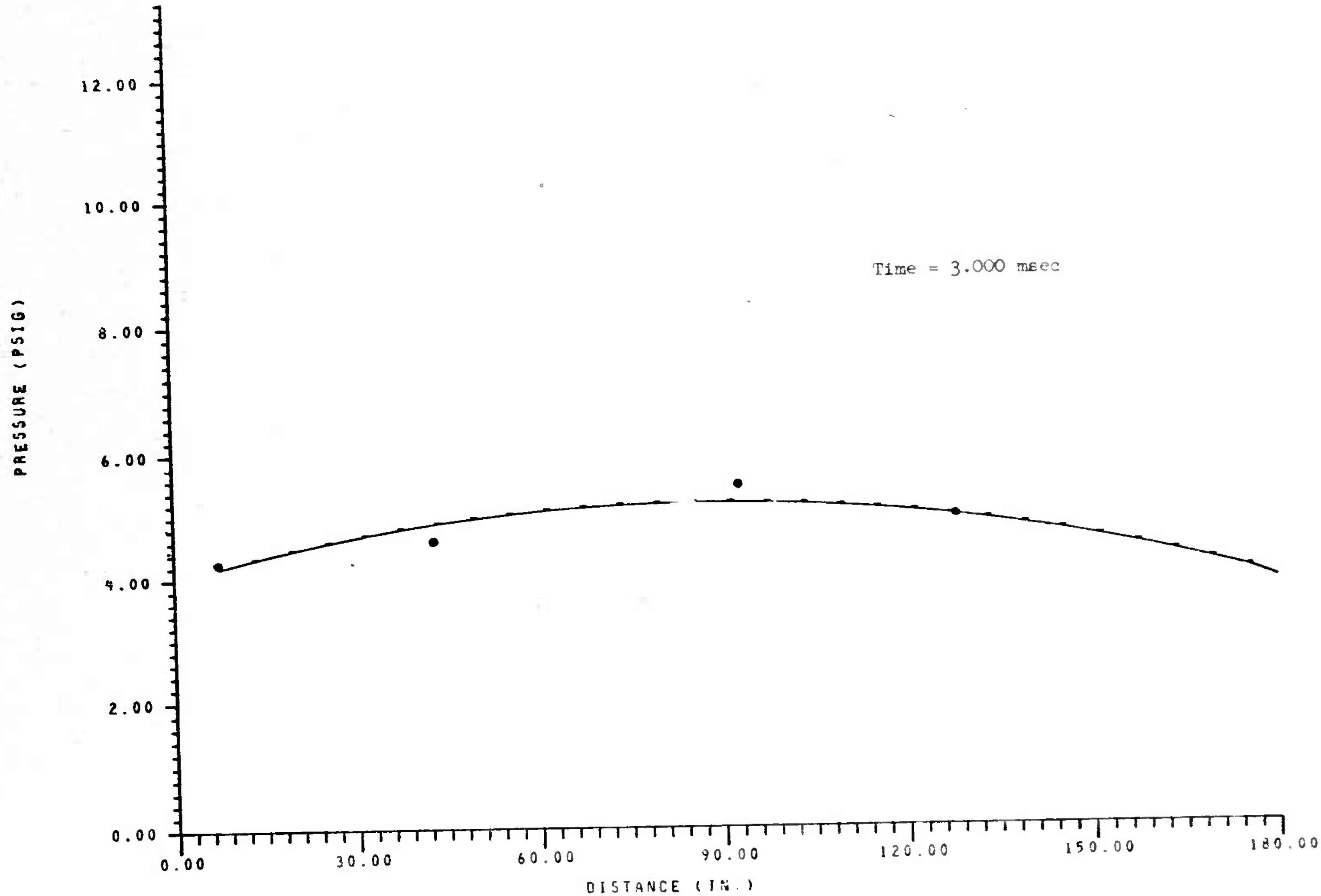
PRESSURE VS ANGLE AT STATION 2 - TEST 114



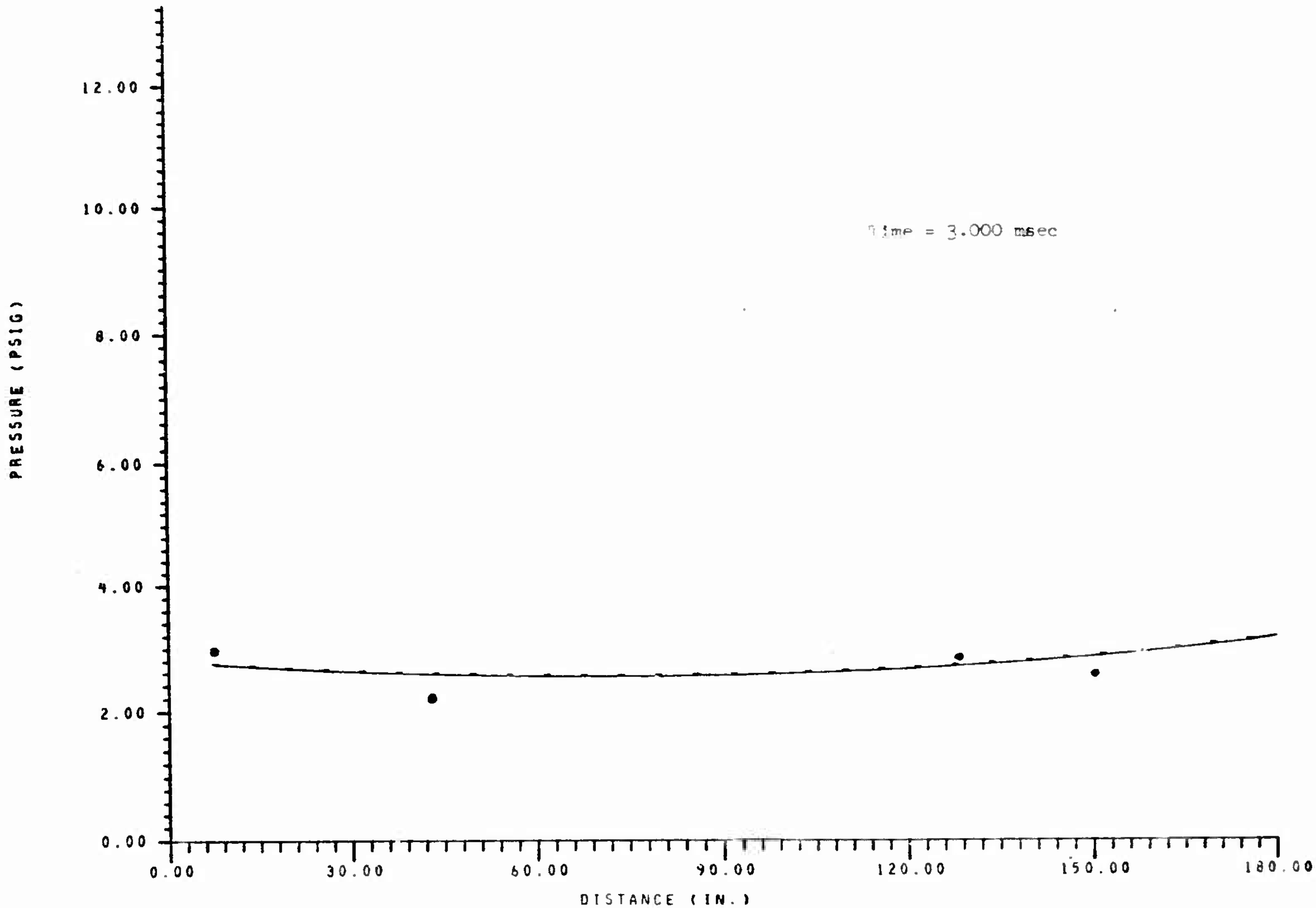
PRESSURE VS ANGLE AT STATION 3 - TEST 114



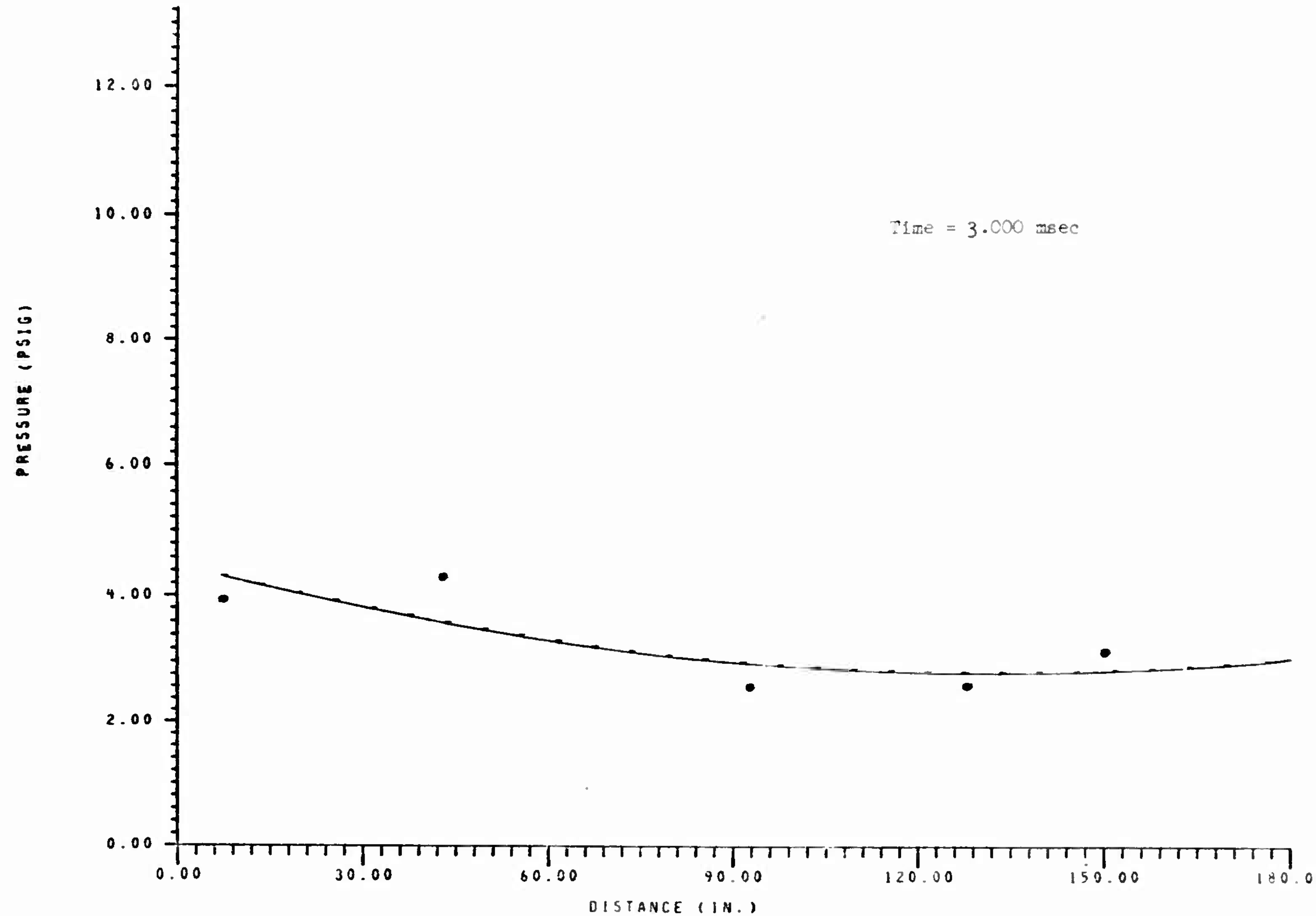
PRESSURE VS ANGLE AT STATION 4 - TEST 114



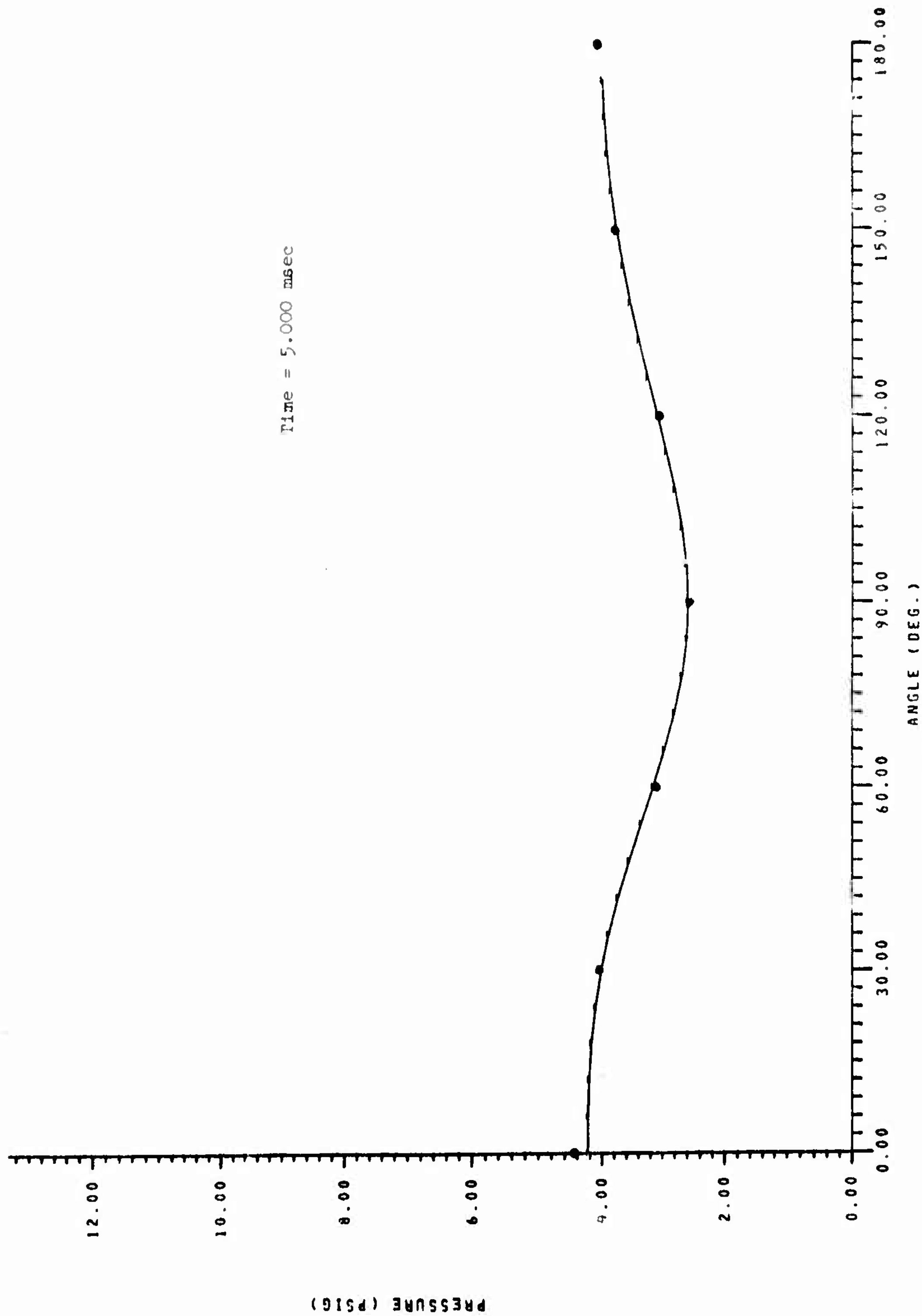
PRESSURE VS DISTANCE AT 0° - TEST 114



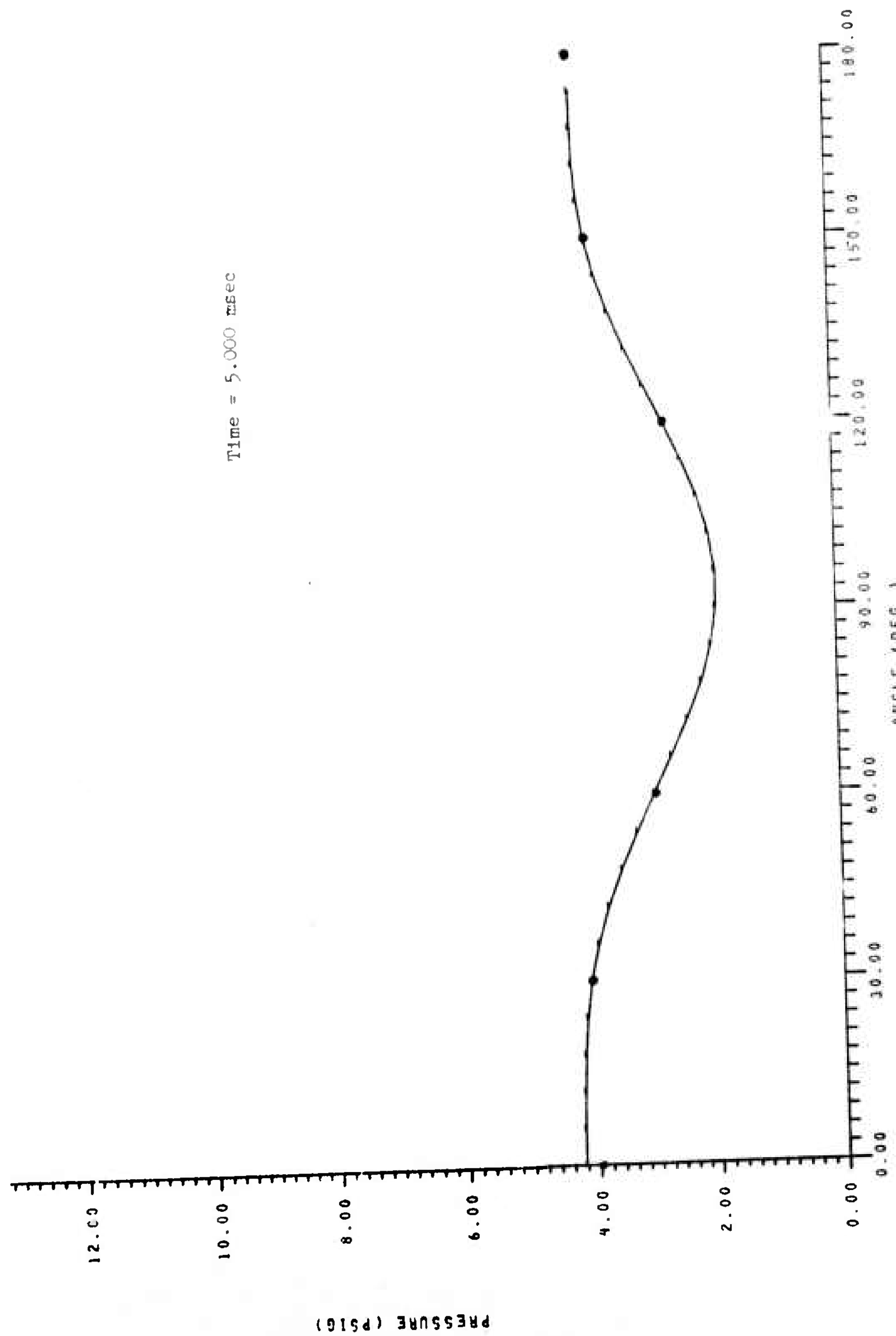
PRESSURE VS DISTANCE AT 90° - TEST 114



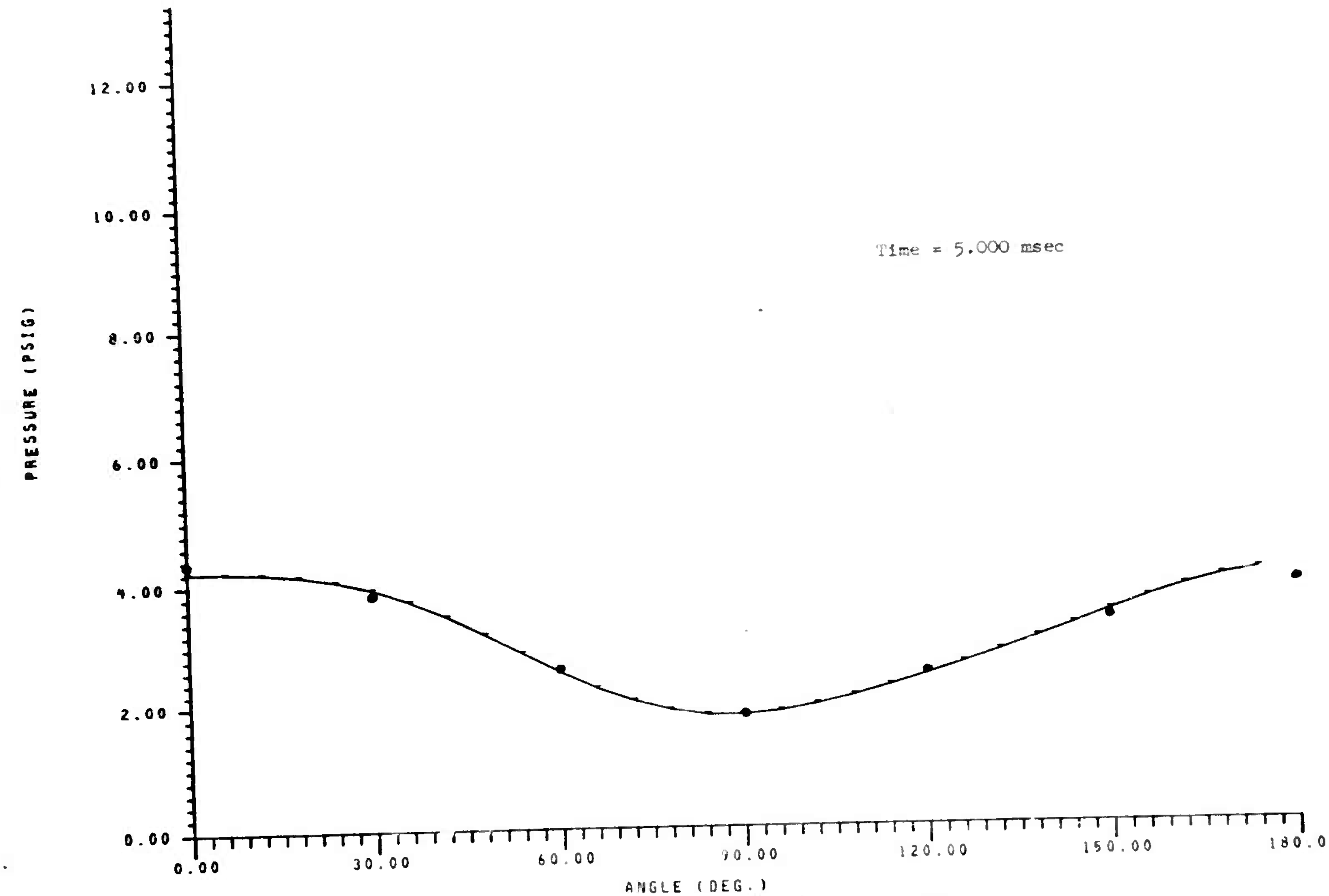
PRESSURE VS DISTANCE AT 180° - TEST 114



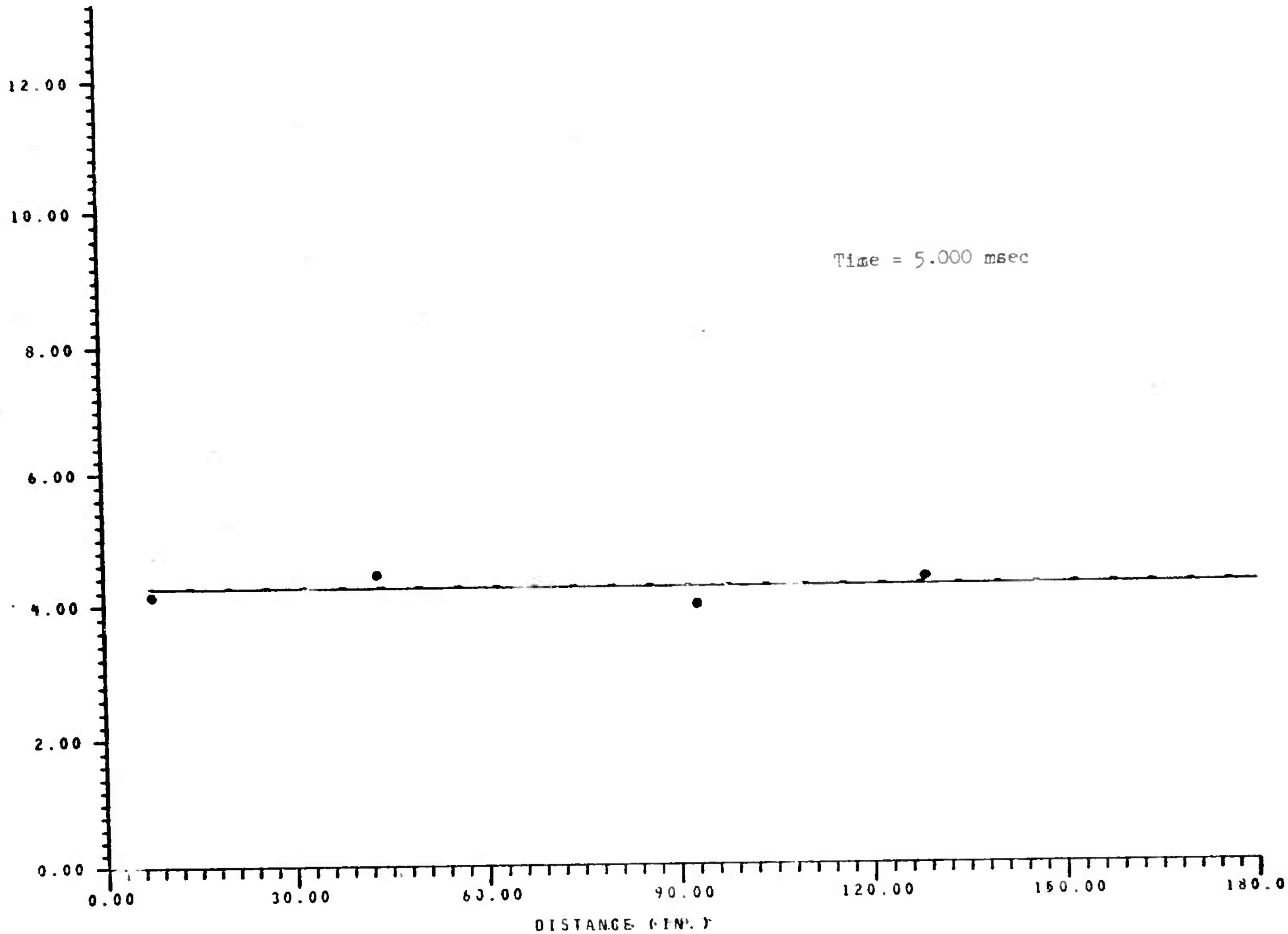
PRESSURE VS ANGLE AT STATION 2 - TEST 114



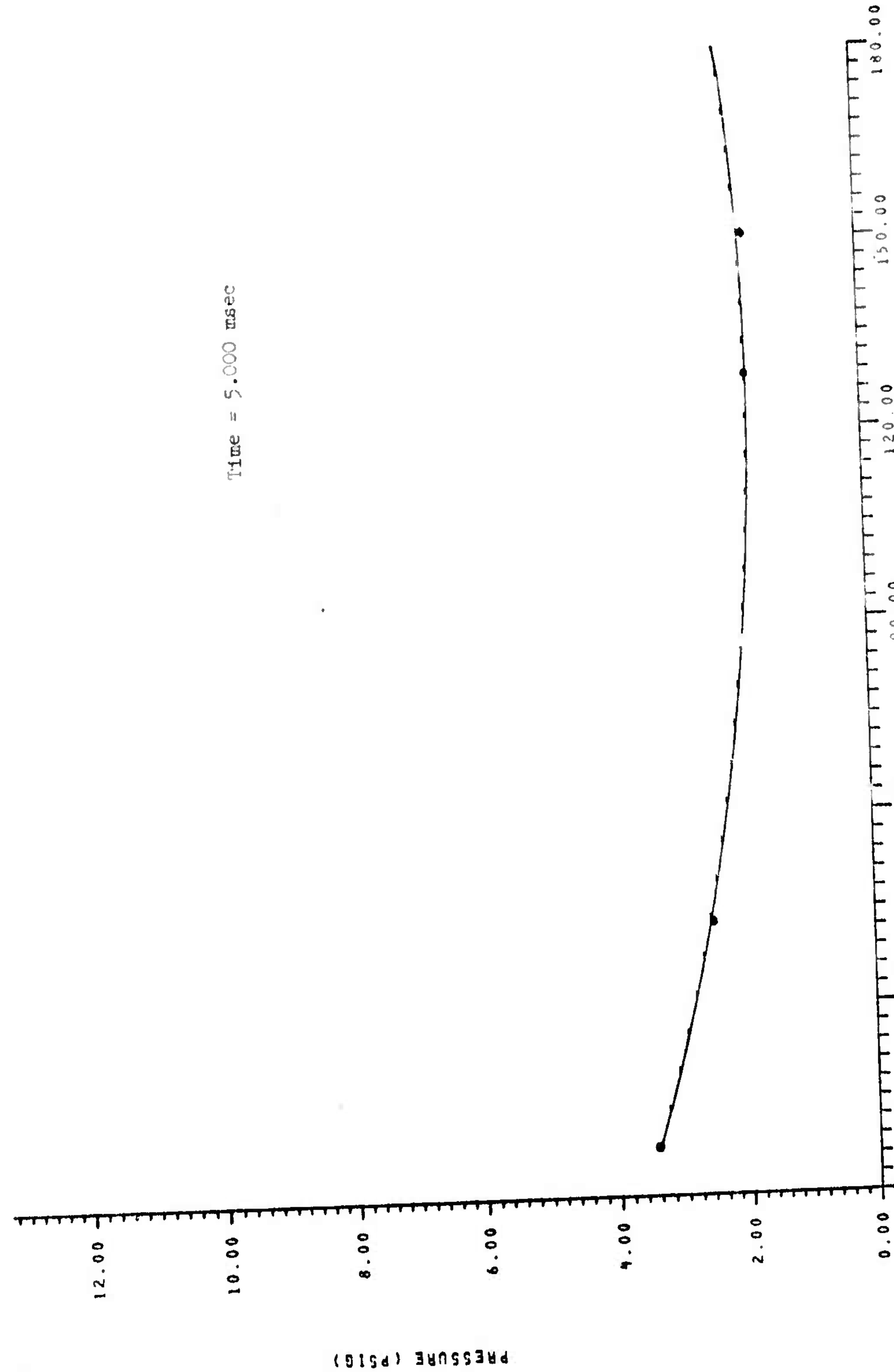
PRESSURE VS ANGLE AT STATION 3 - TEST 114



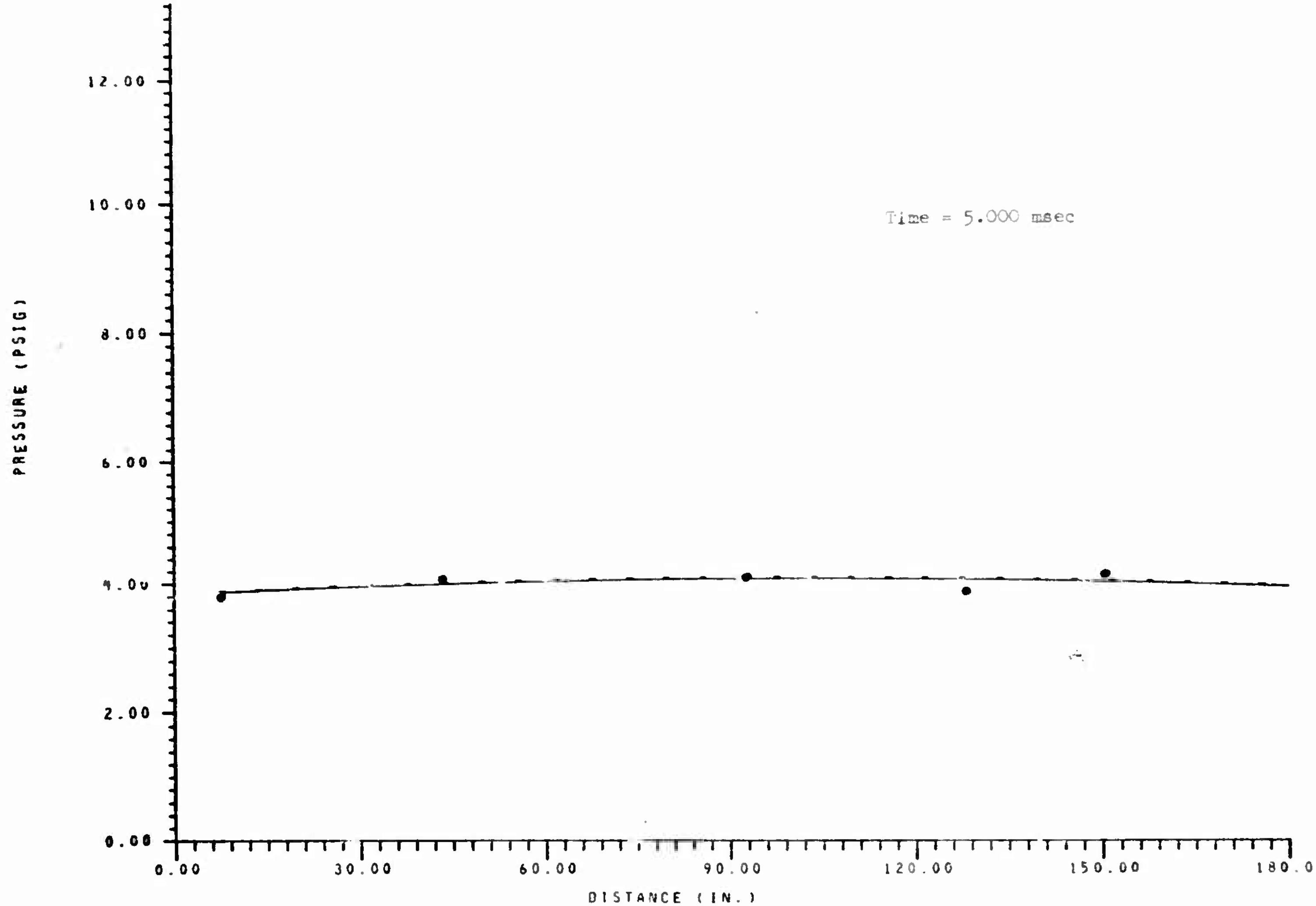
PRESSURE VS ANGLE AT STATION 4 - TEST 114



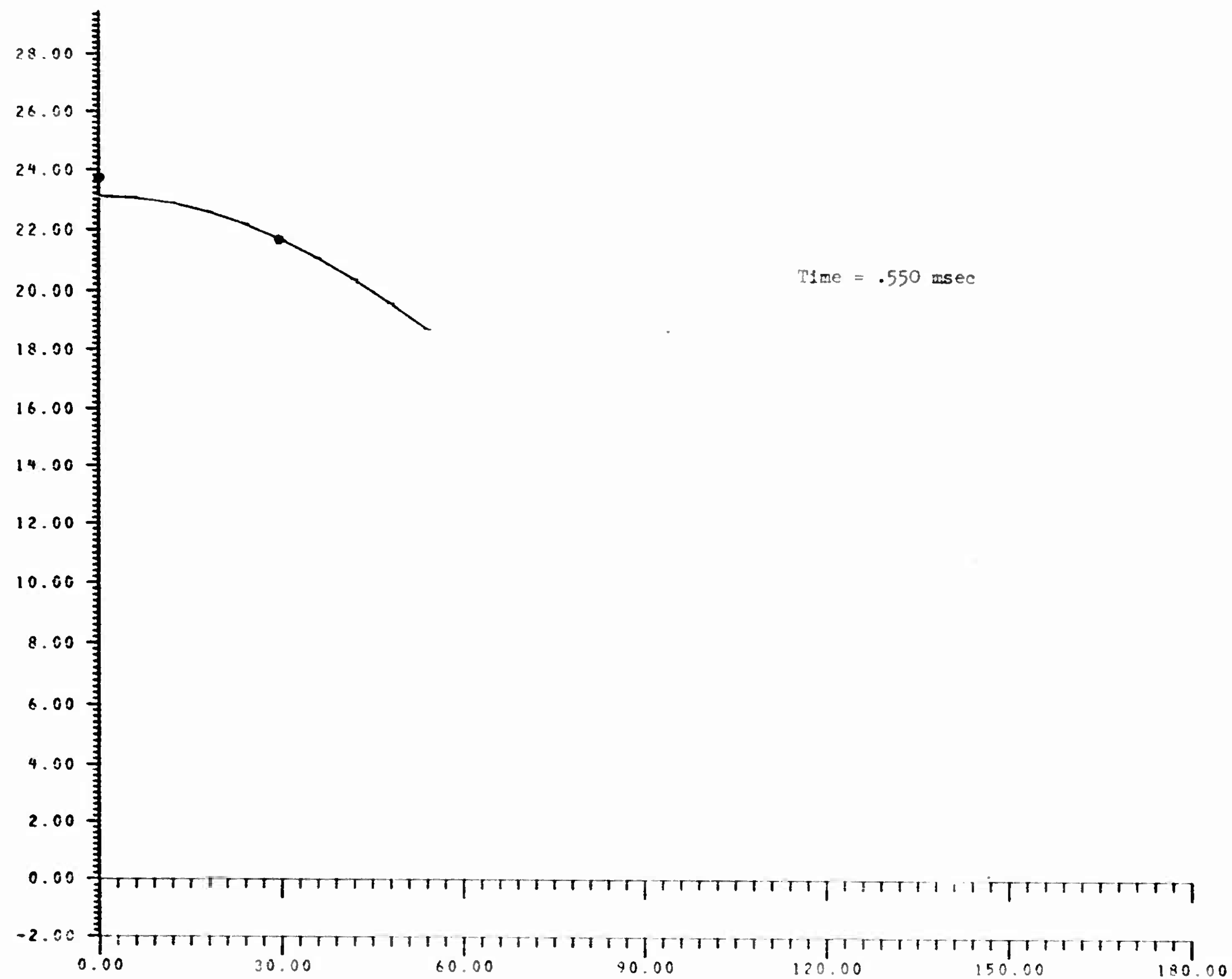
PRESSURE VS DISTANCE AT 0° - TEST 114



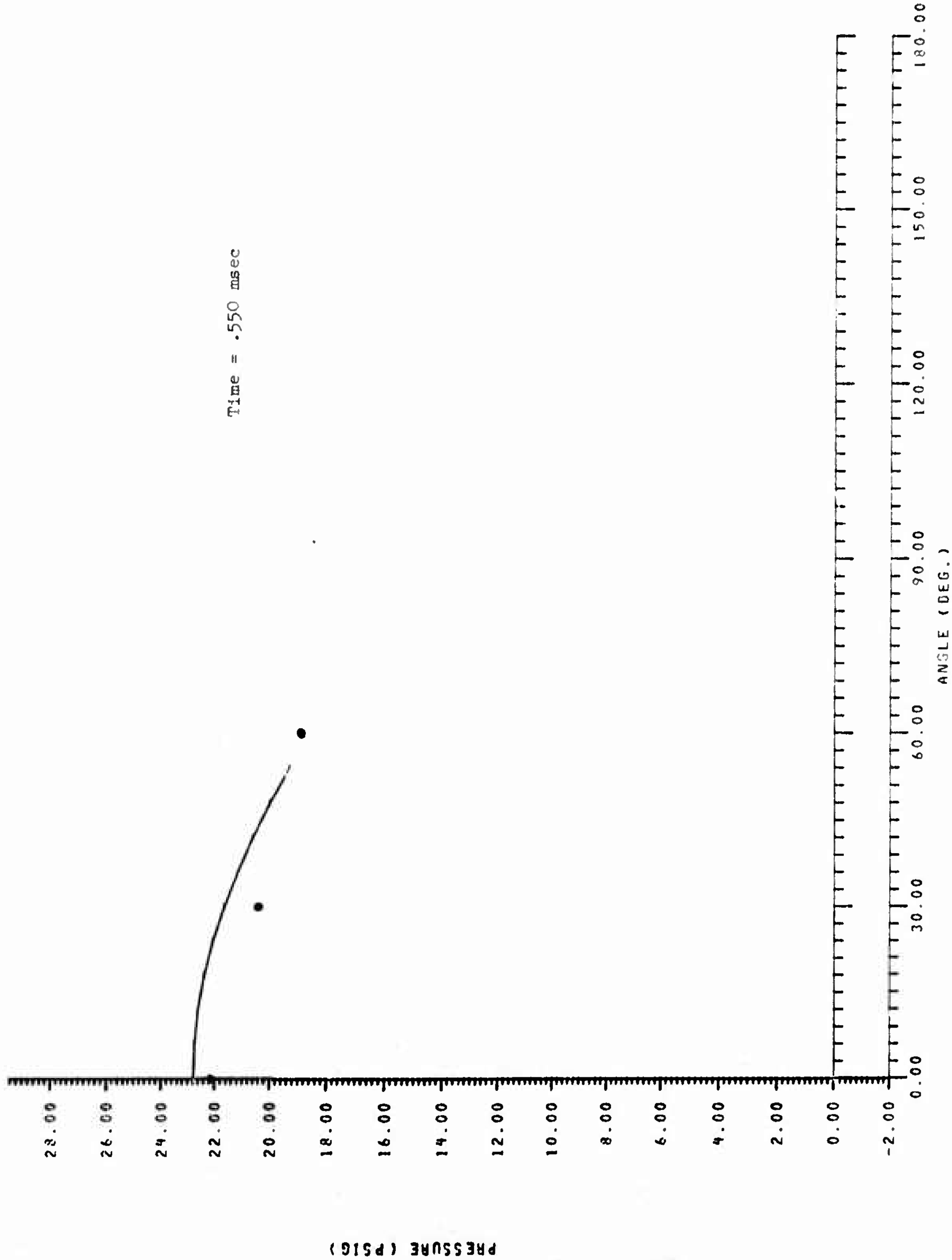
PRESSURE VS DISTANCE AT 90° - TEST 114



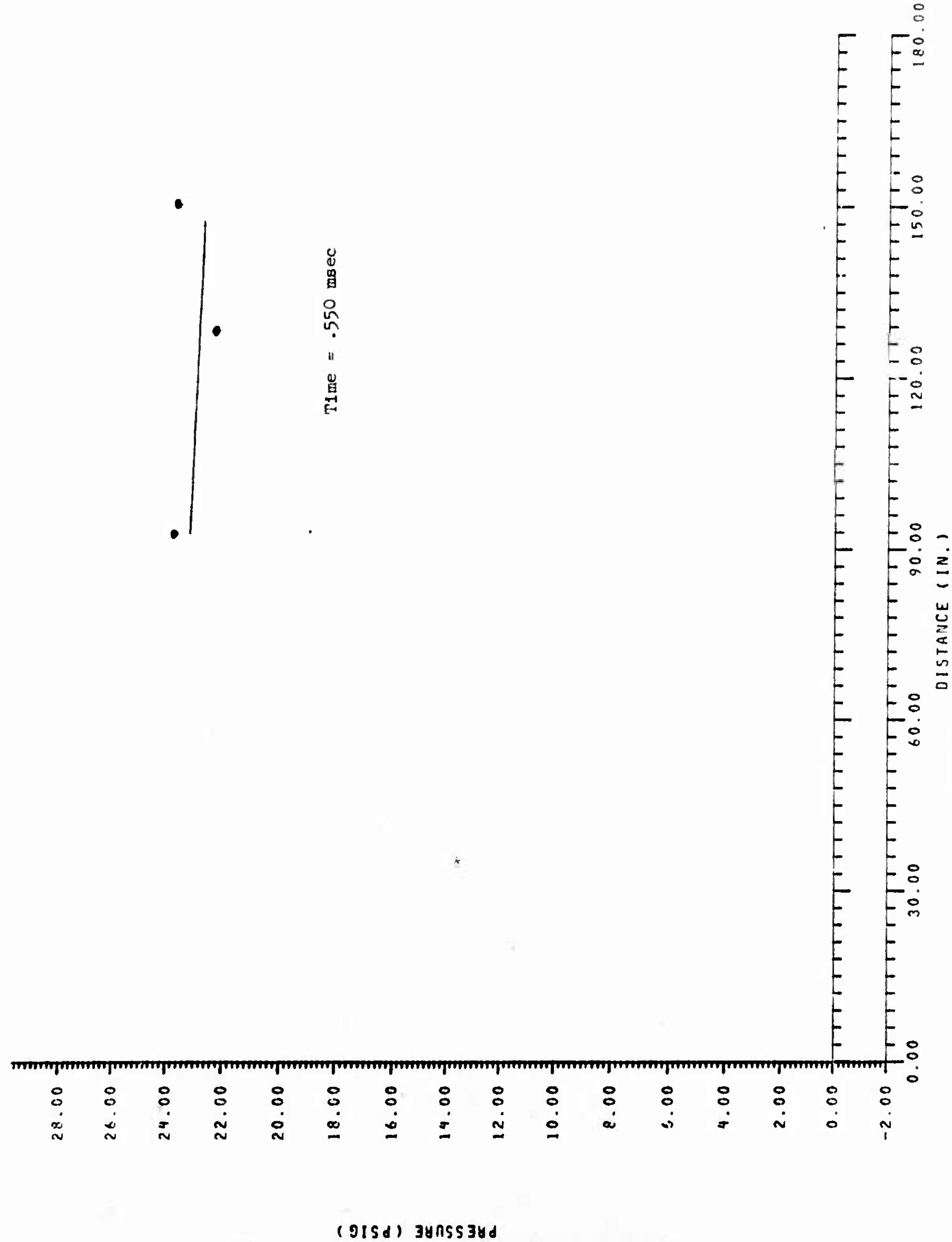
PRESSURE VS DISTANCE AT 180° - TEST 114



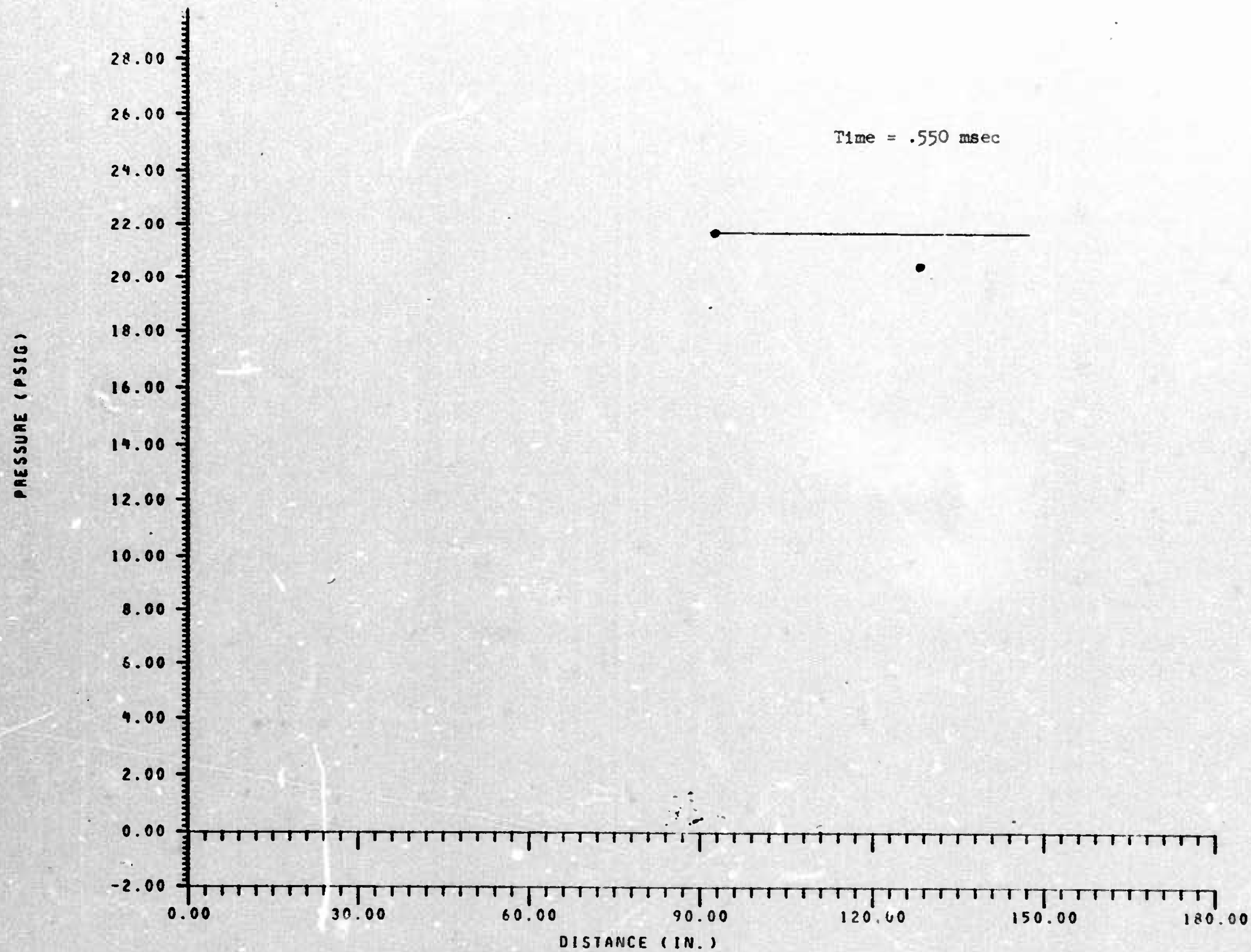
PRESSURE VS ANGLE AT STATION 3 - TEST 116



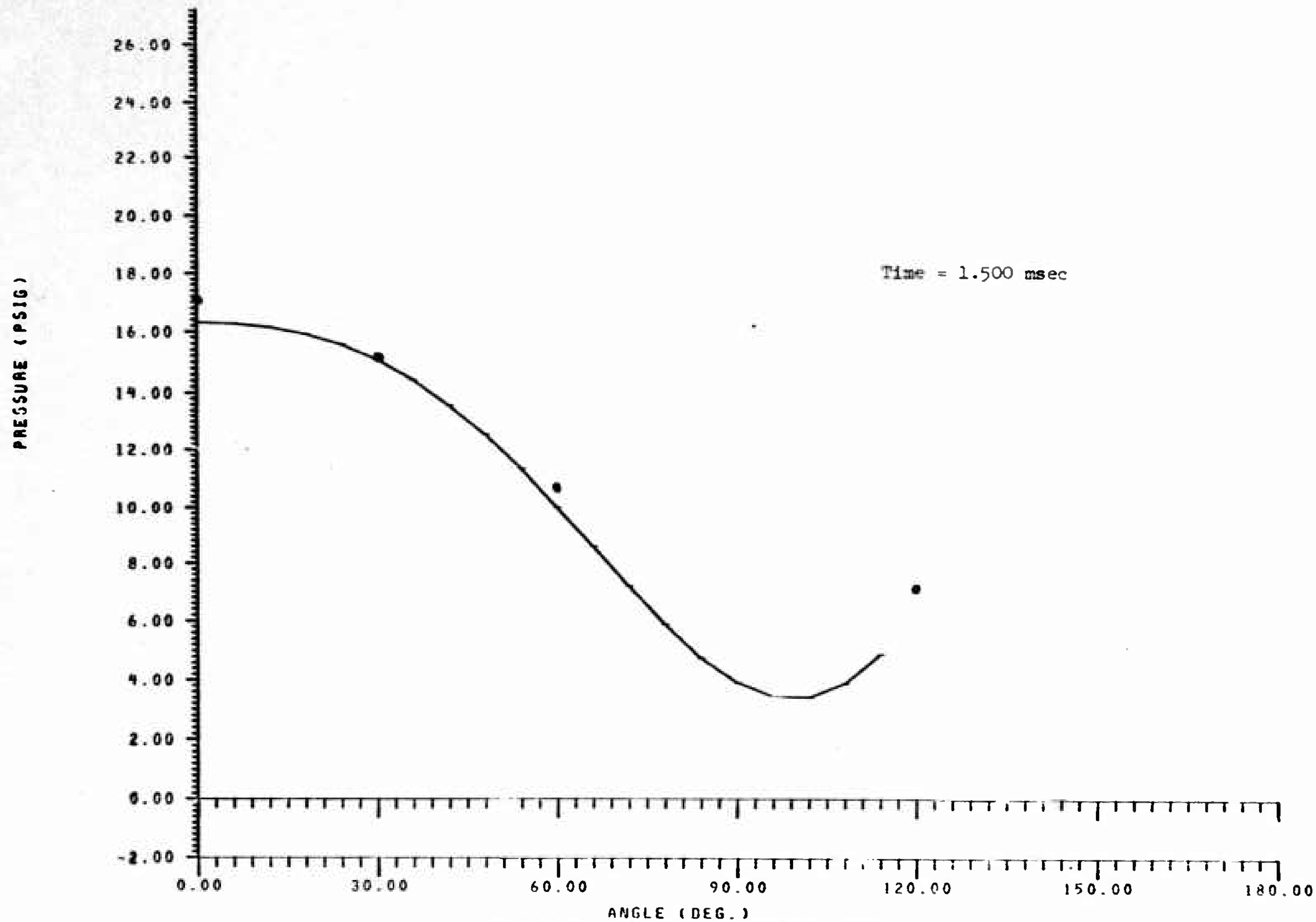
PRESSURE VS ANGLE AT STATION 4 - TEST 116



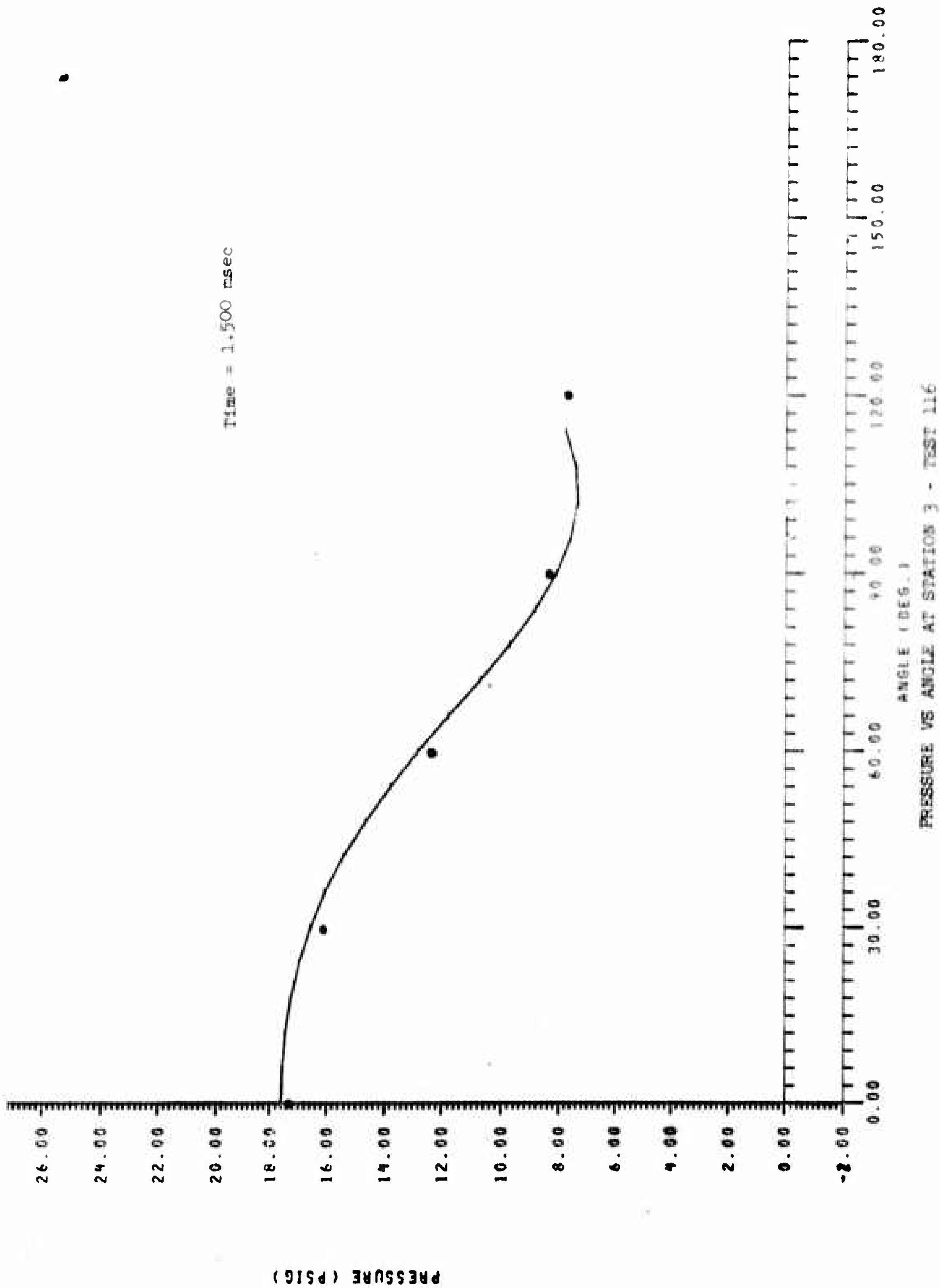
PRESSURE VS DISTANCE AT 0° - TEST 116



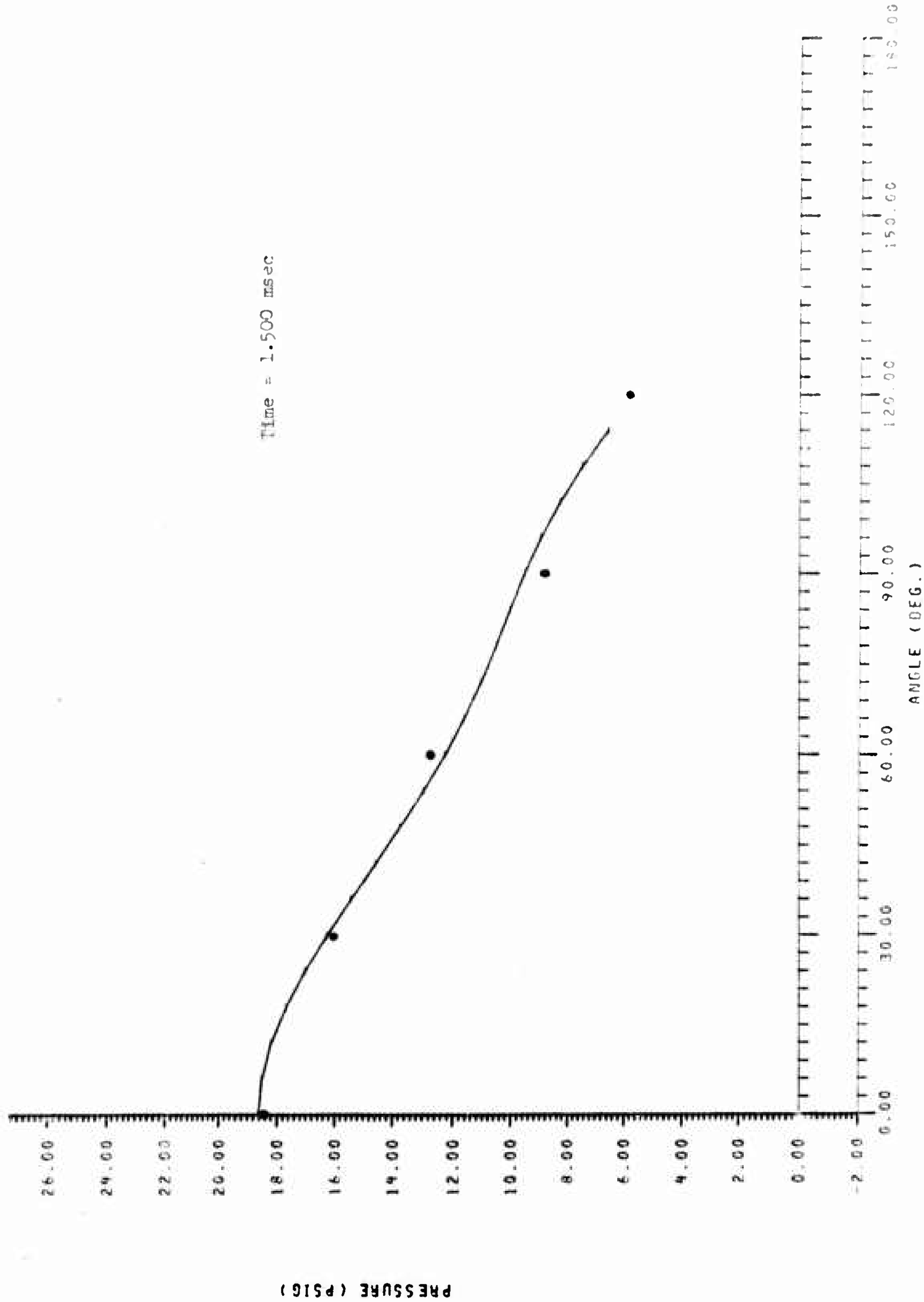
PRESSURE VS DISTANCE AT 30° - TEST 116



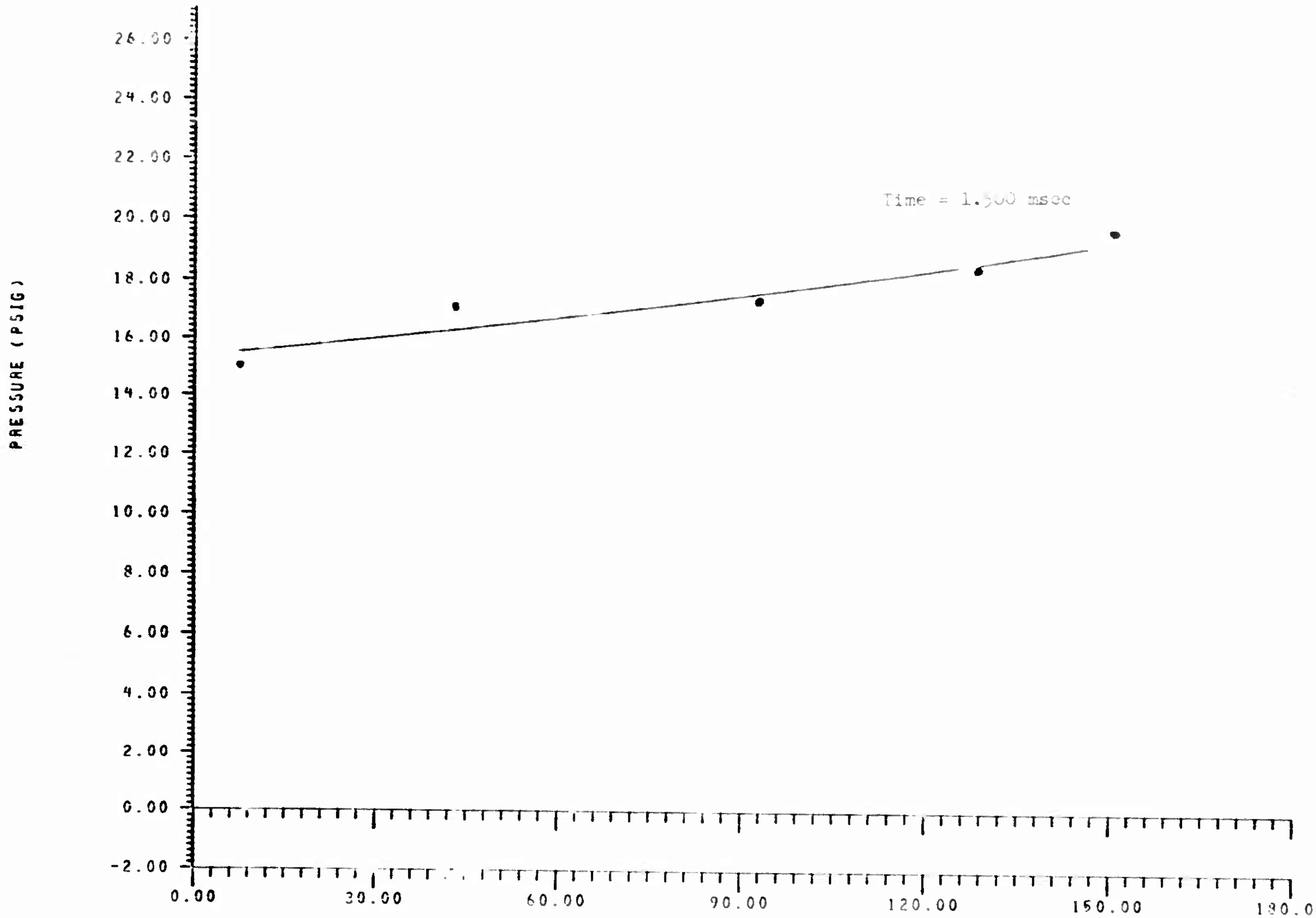
PRESSURE VS ANGLE AT STATION 2 - TEST 116



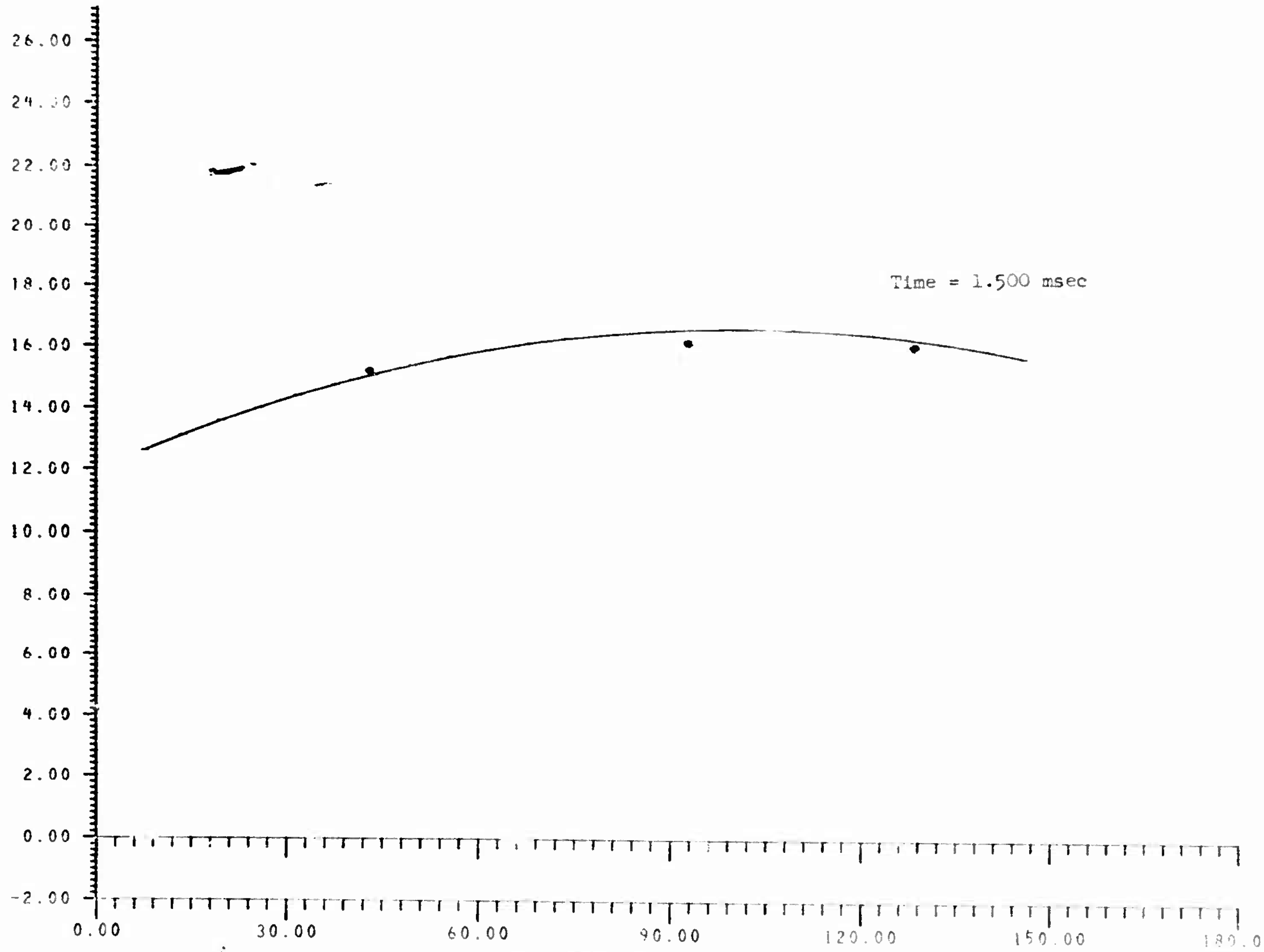
Time = 1.500 msec
PRESSURE (PSIG)
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
0.00
30.00
60.00
90.00
120.00
150.00
180.00
ANGLE (DEG.)
PRESSURE VS ANGLE AT STATION 3 - TEST 116



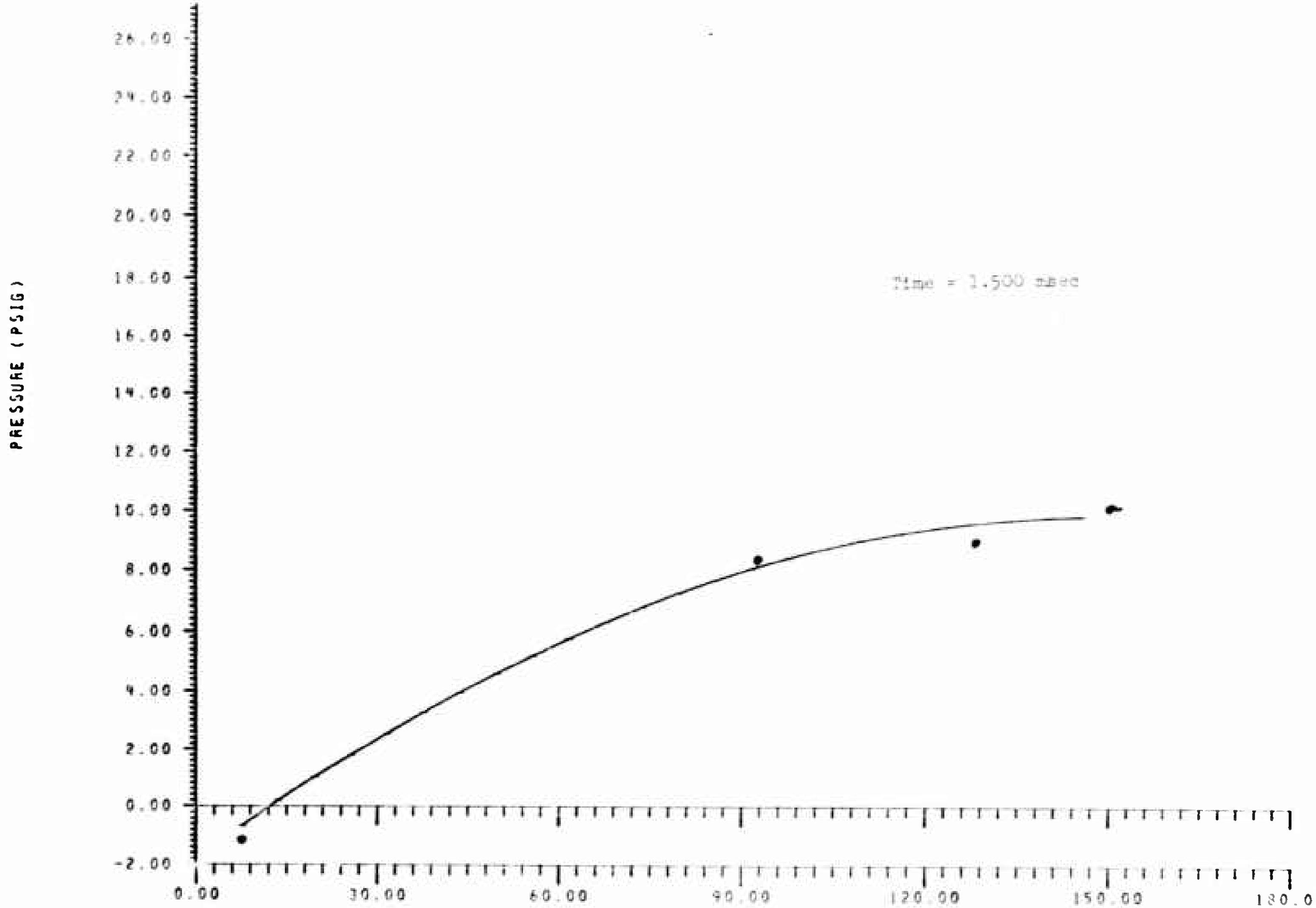
FRESSURE VS ANGLE AT STATION 4 - TEST 116



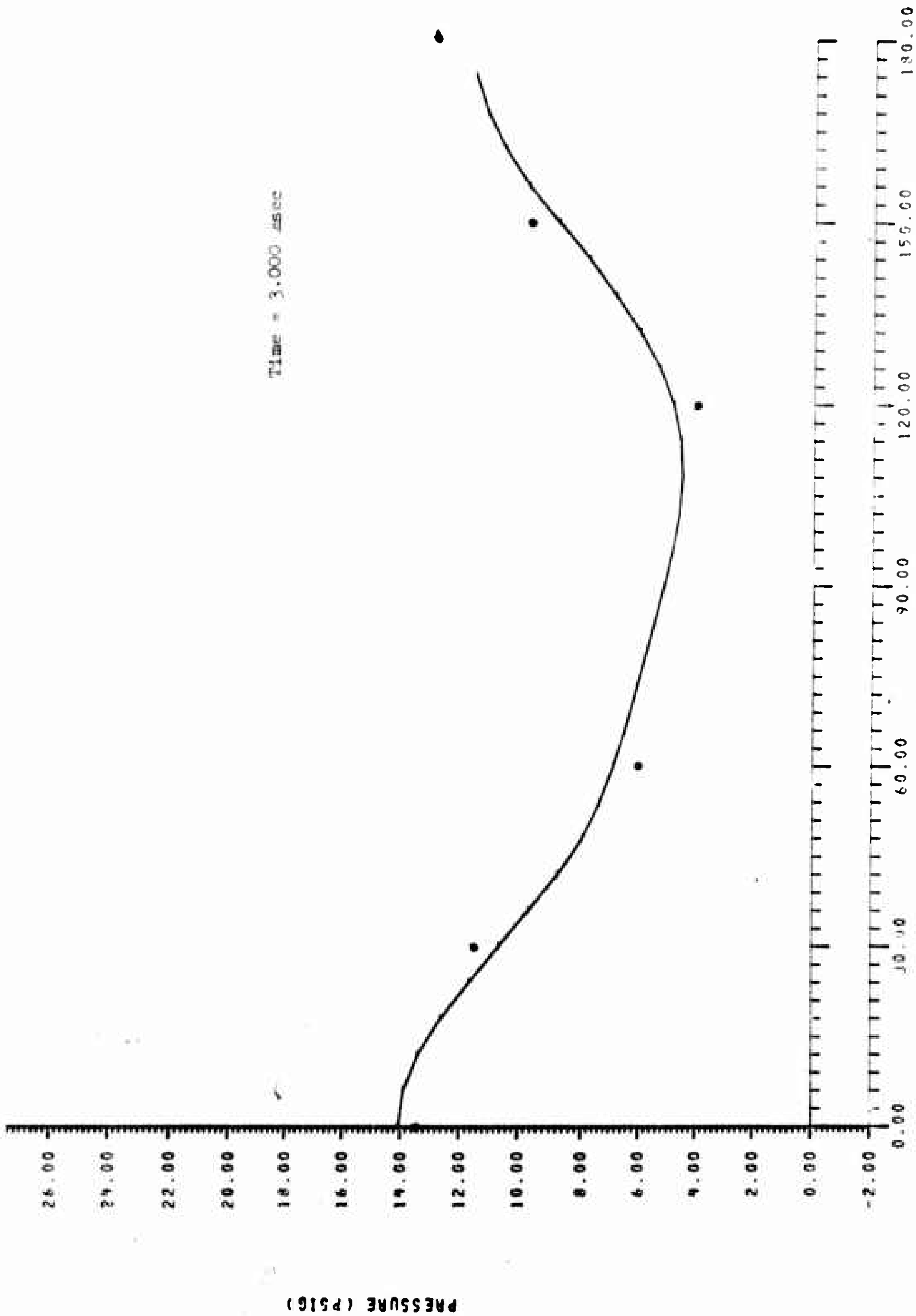
PRESSURE VS DISTANCE AT 0° - TEST 116



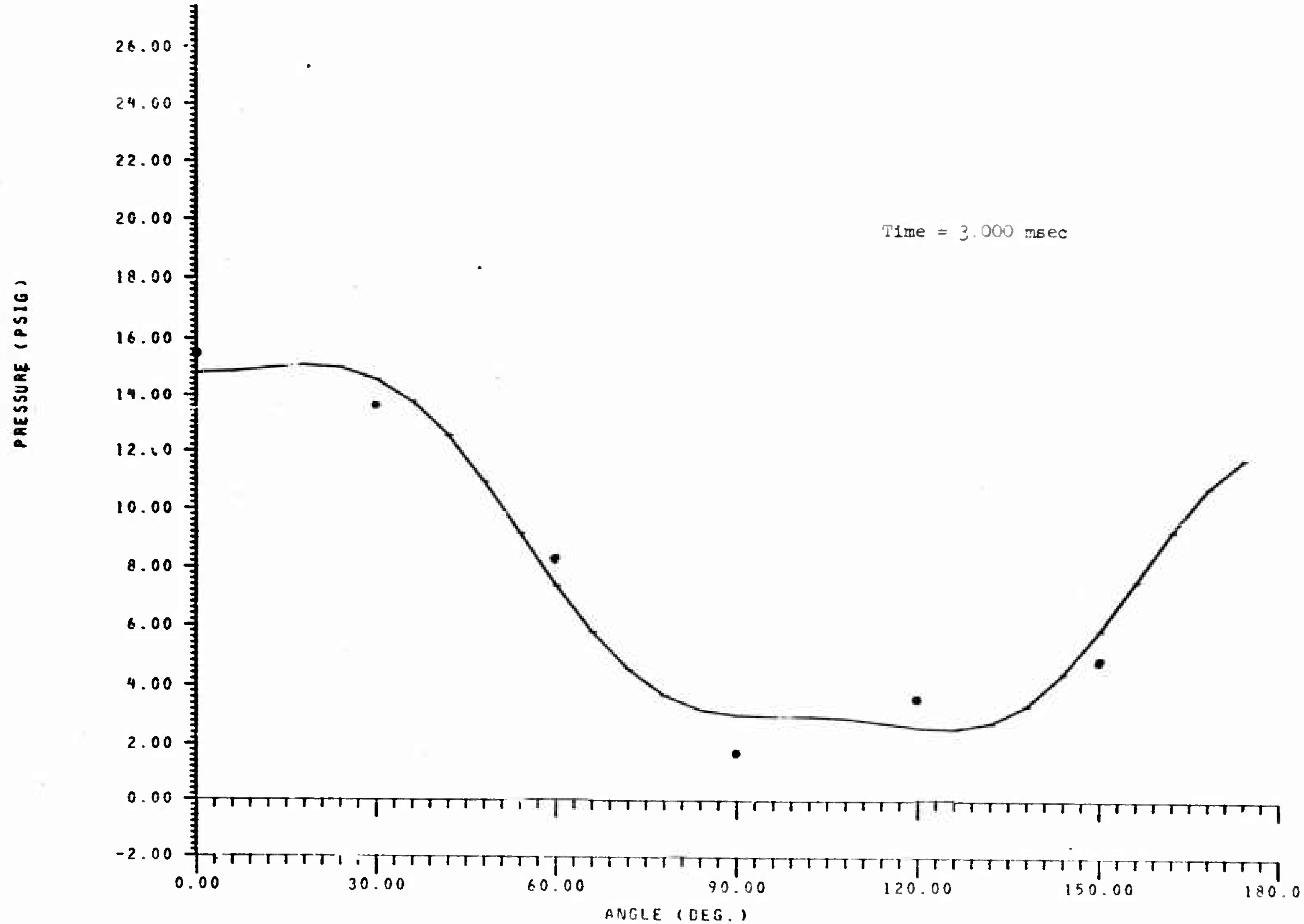
PRESSURE VS DISTANCE AT 60° - TEST 116



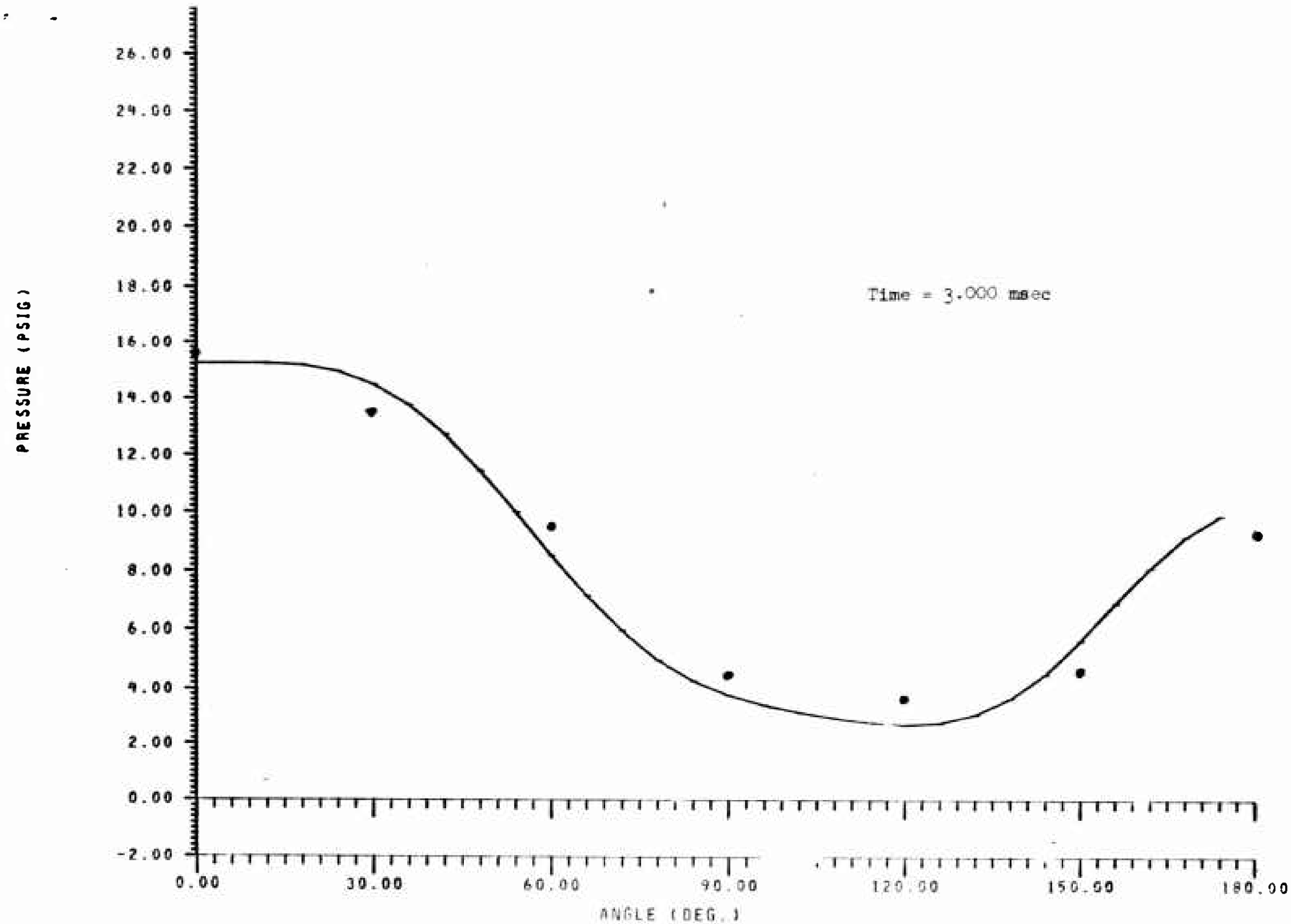
PRESSURE VS DISTANCE AT 90° - TEST 116



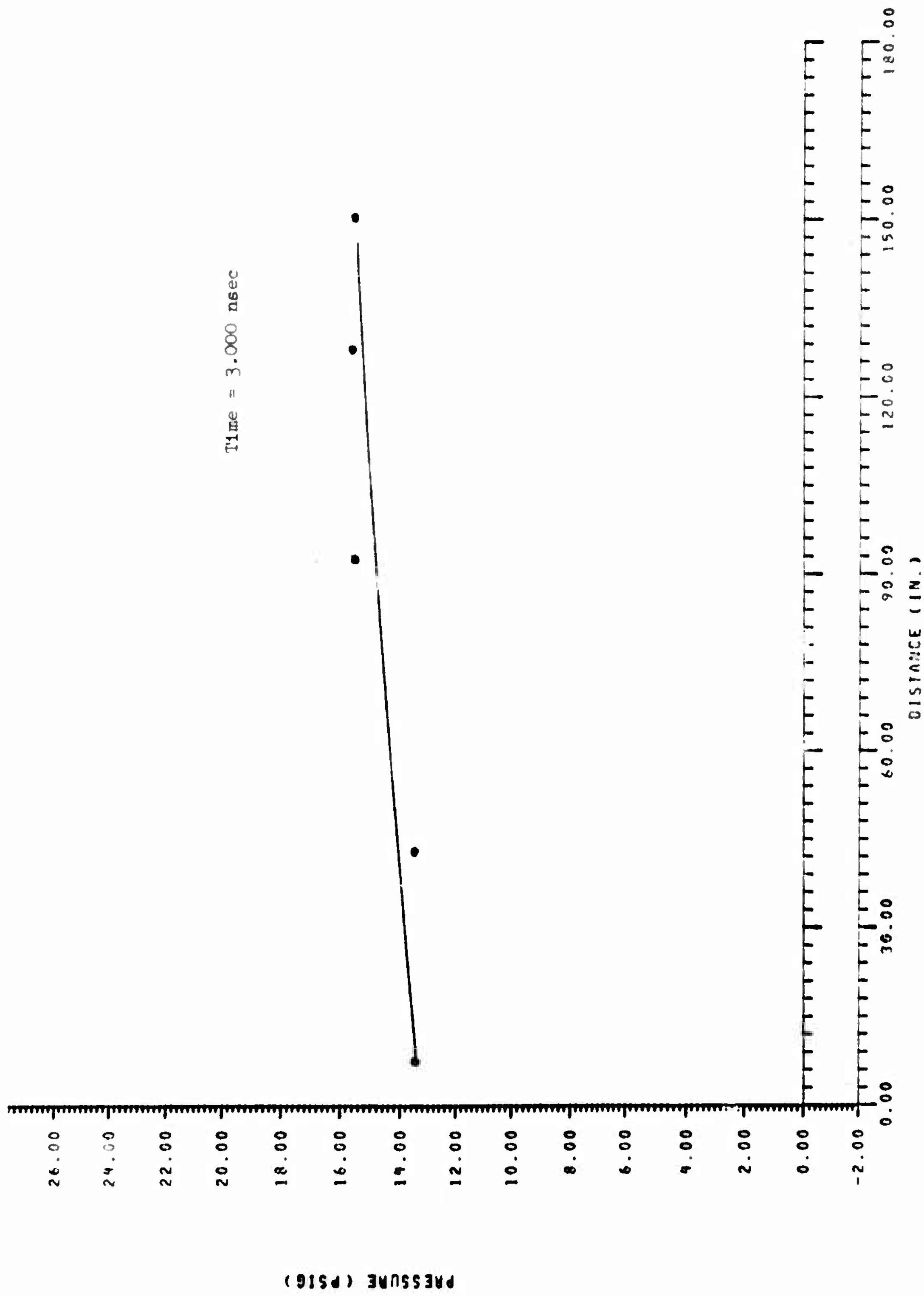
PRESSURE VS ANGLE AT STATION 2 - TEST 116



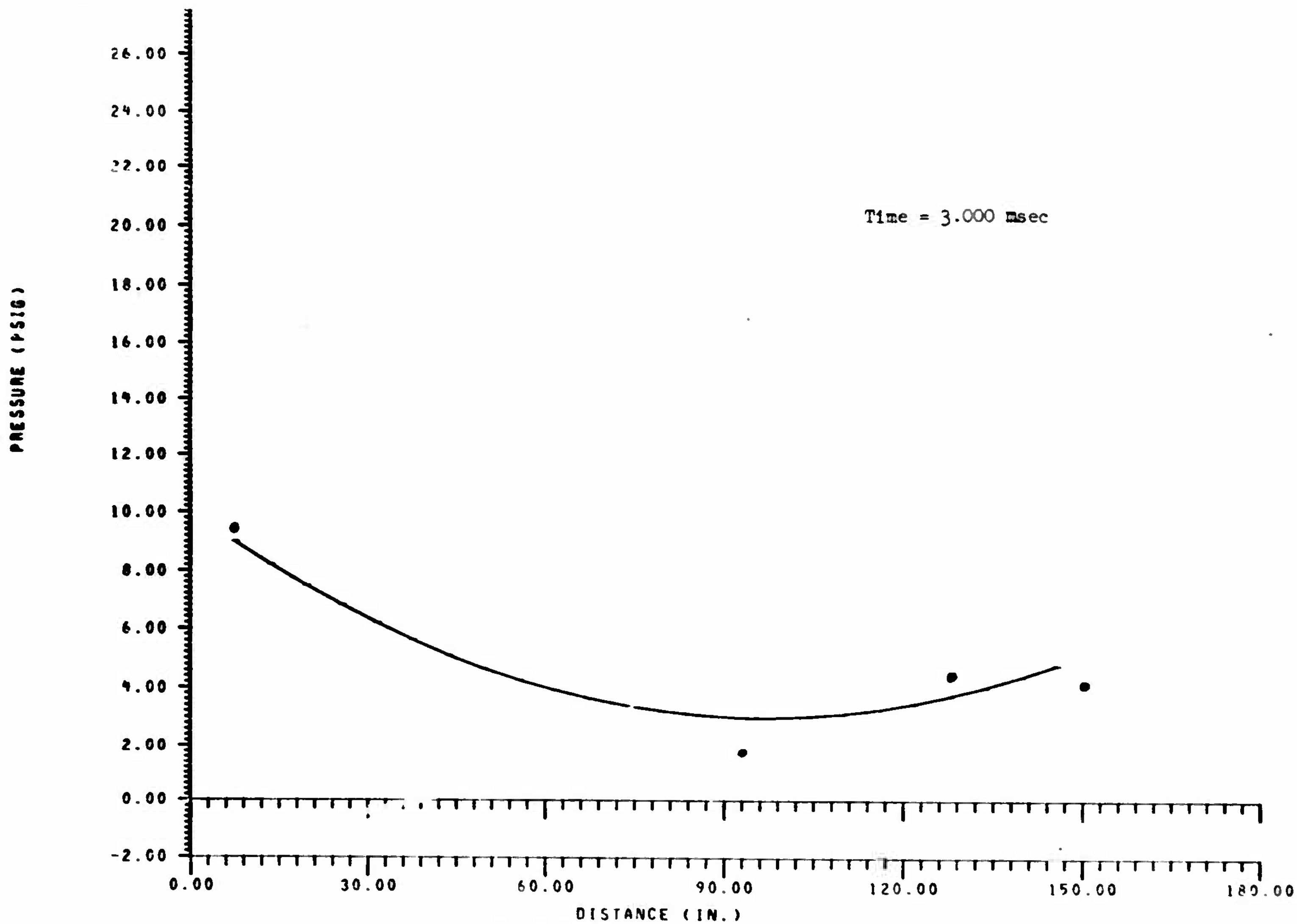
PRESSURE VS ANGLE AT STATION 3 - TEST 116



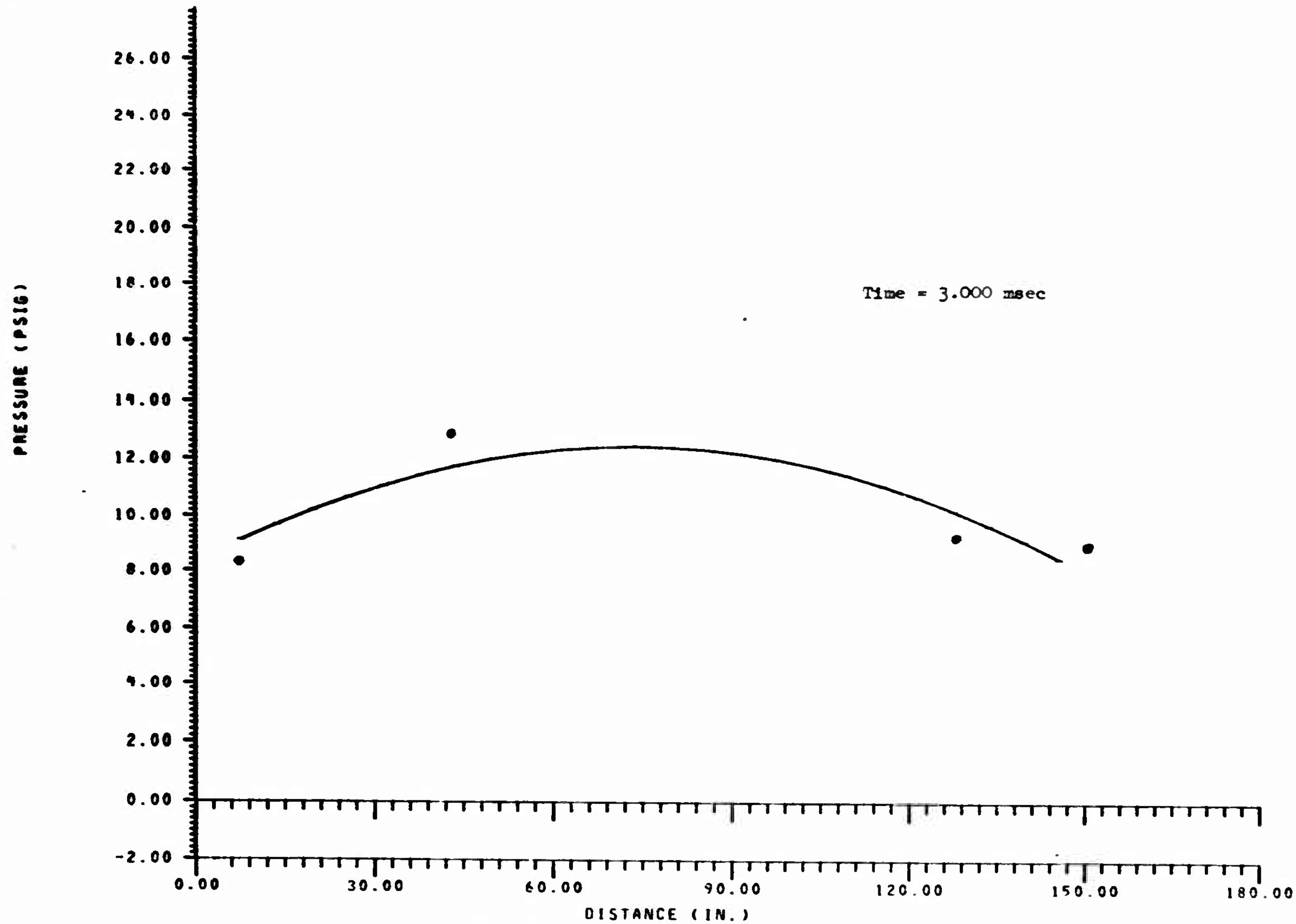
PRESSURE VS ANGLE AT STATION 4 - TEST 116



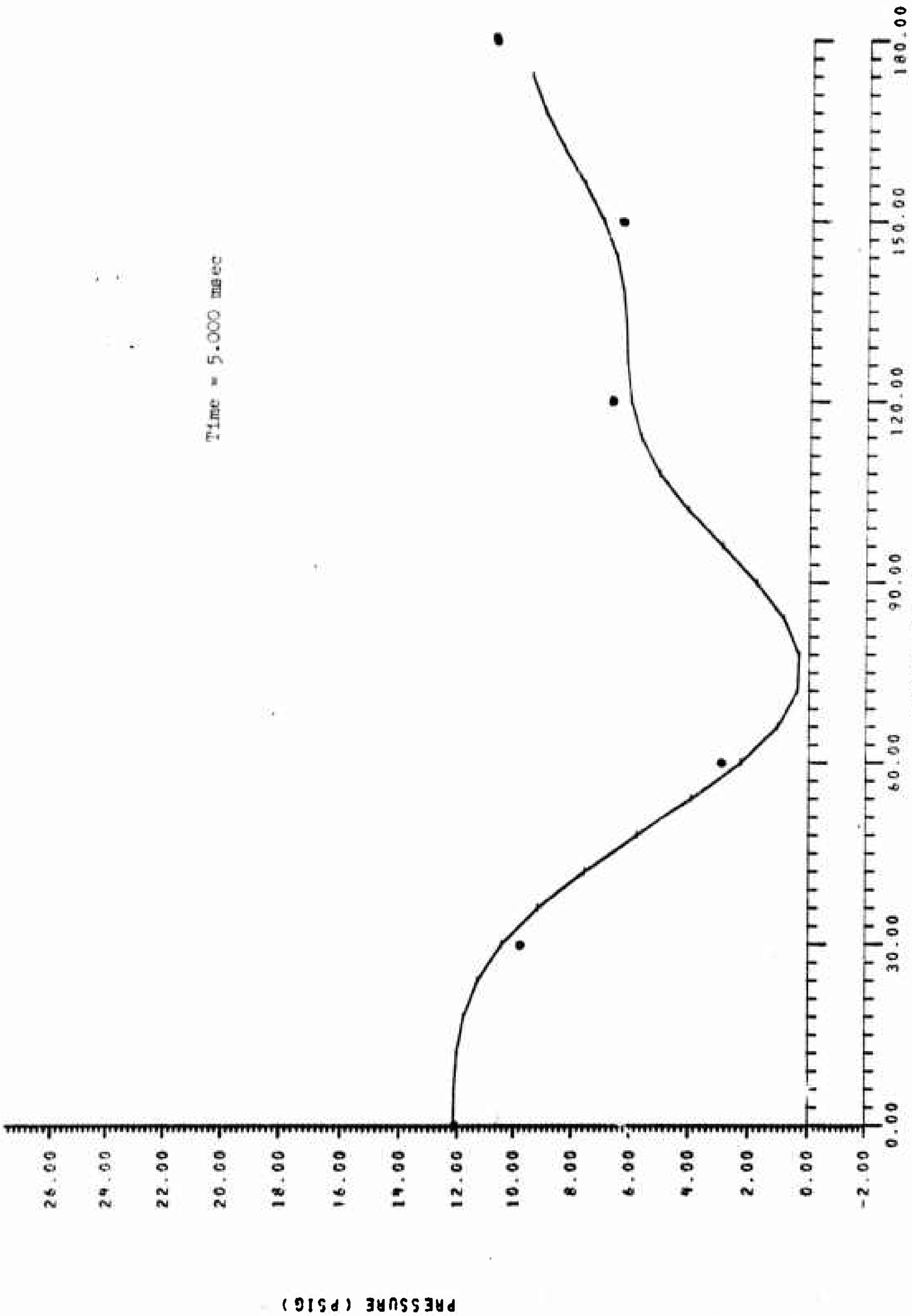
PRESSURE VS DISTANCE AT 0° - TEST 116



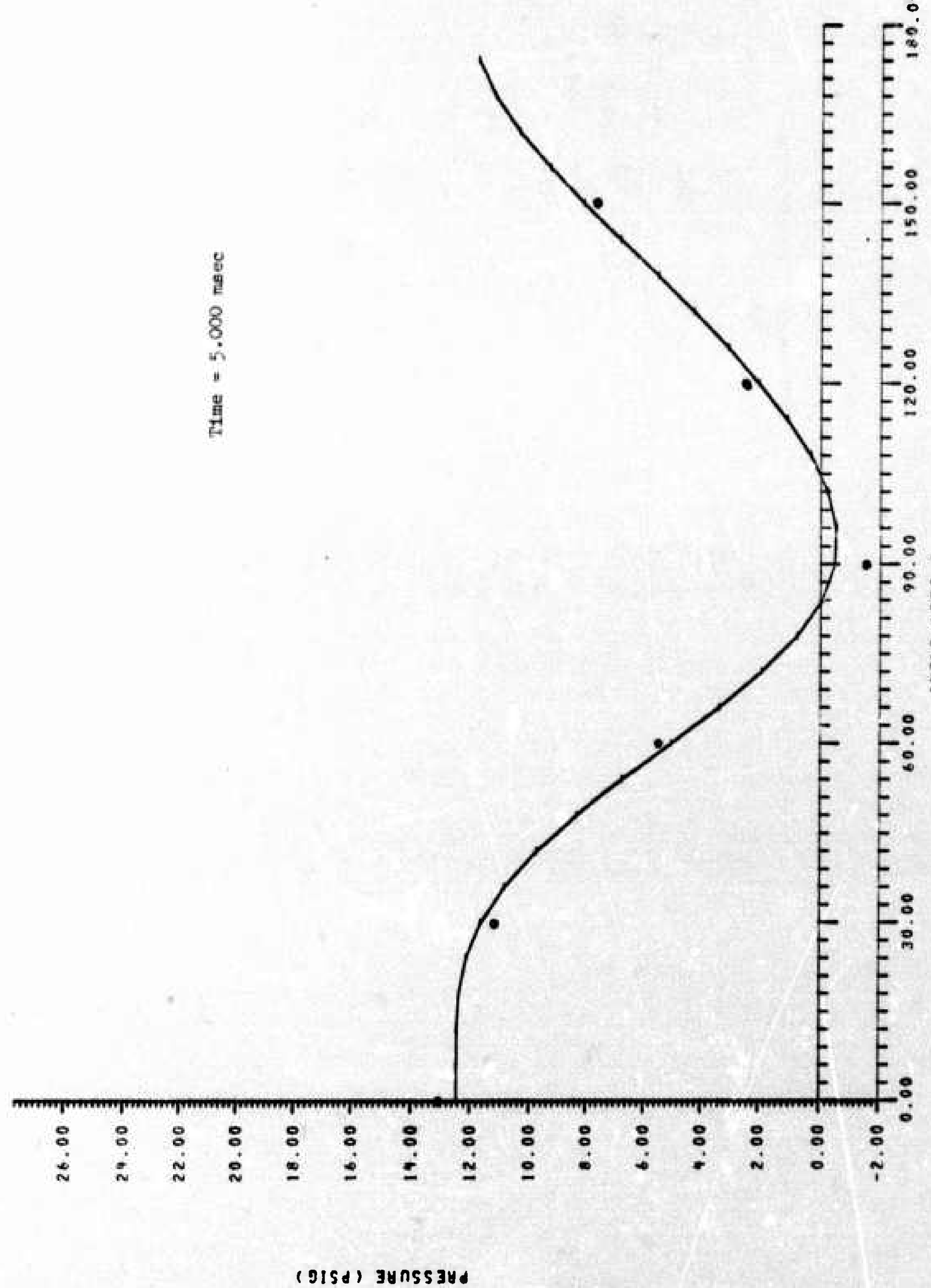
PRESSURE VS DISTANCE AT 90° - TEST IIC



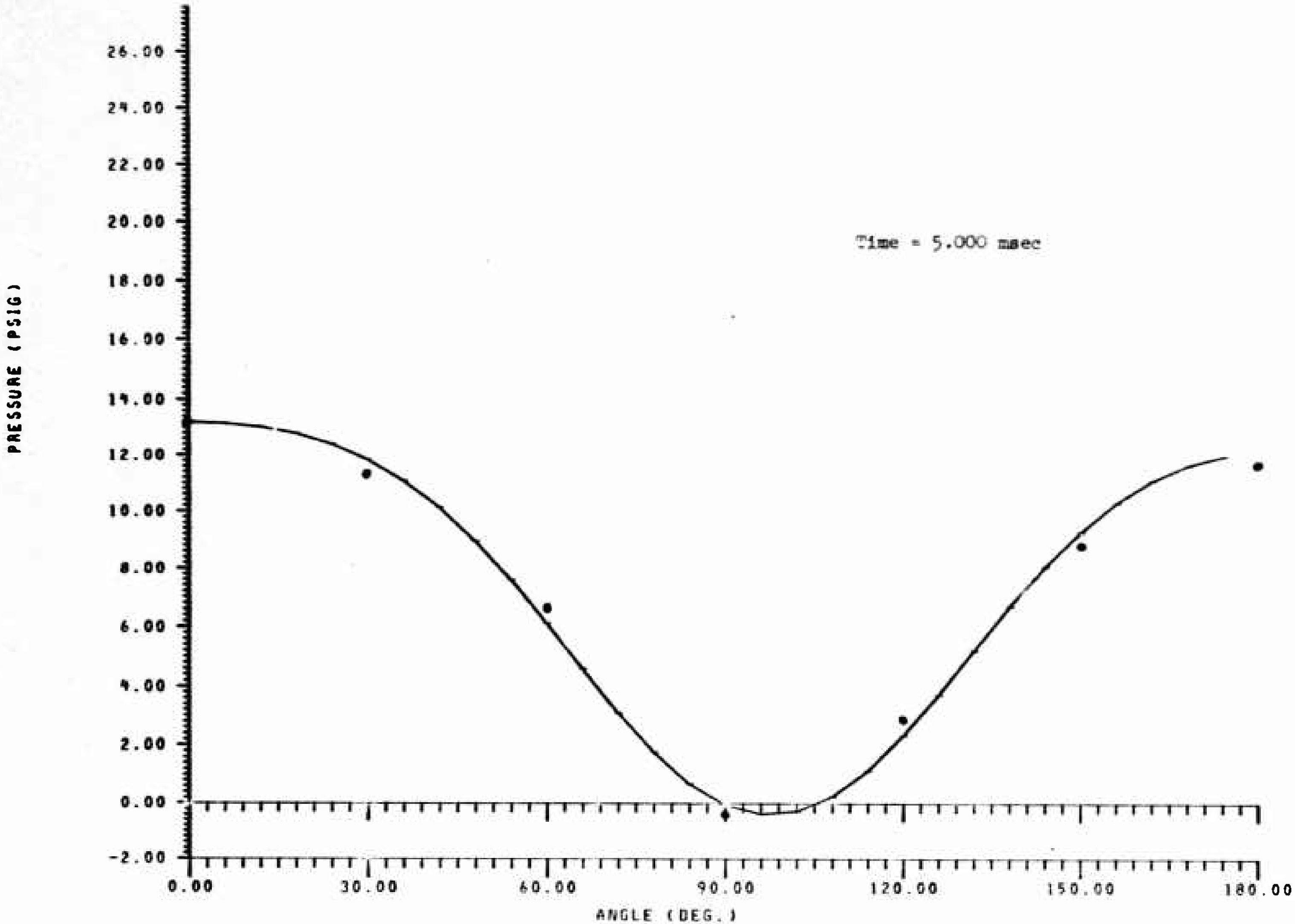
PRESSURE VS DISTANCE AT 180° - TEST 116



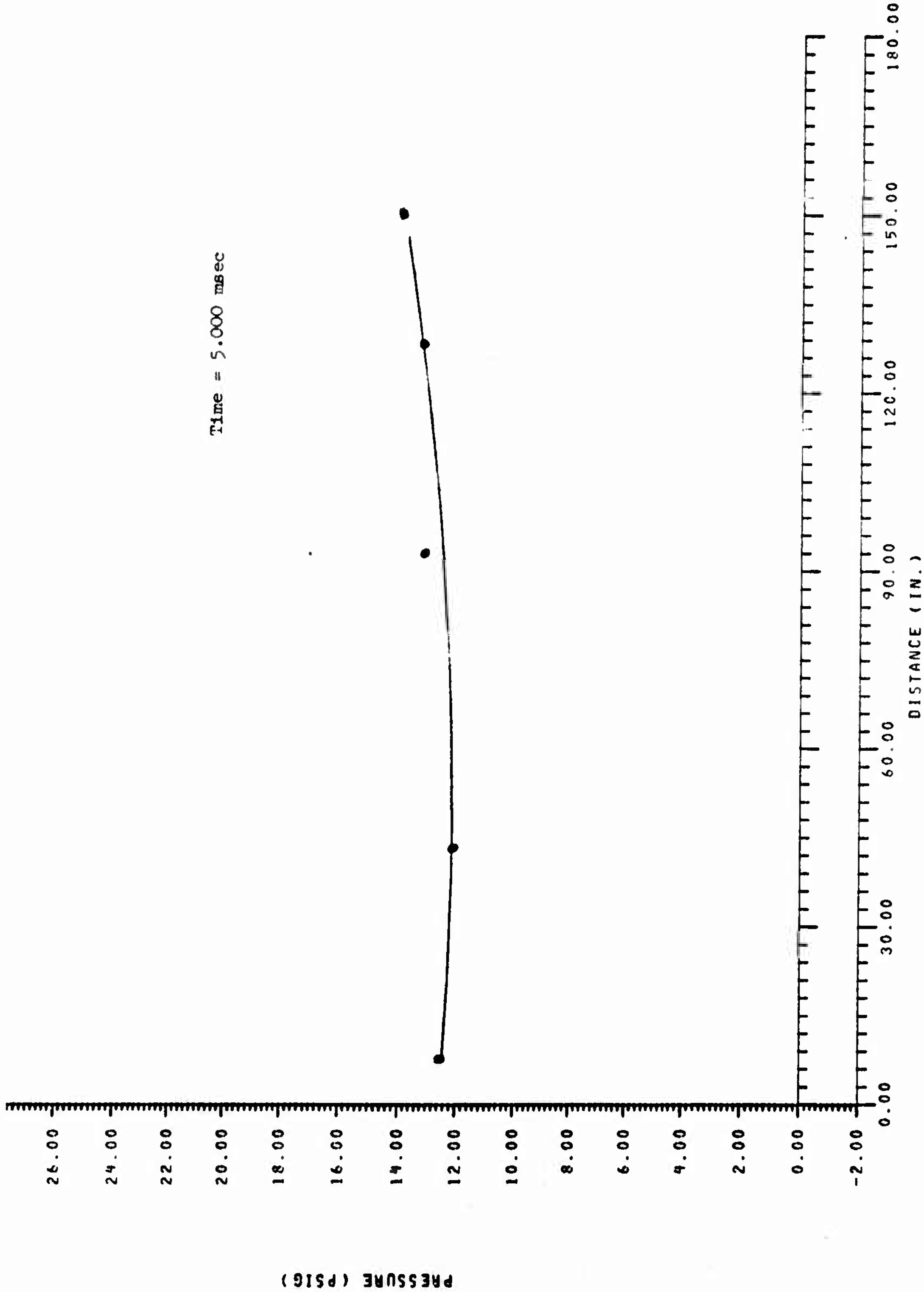
PRESSURE VS ANGLE AT STATION 2 - TEST 116



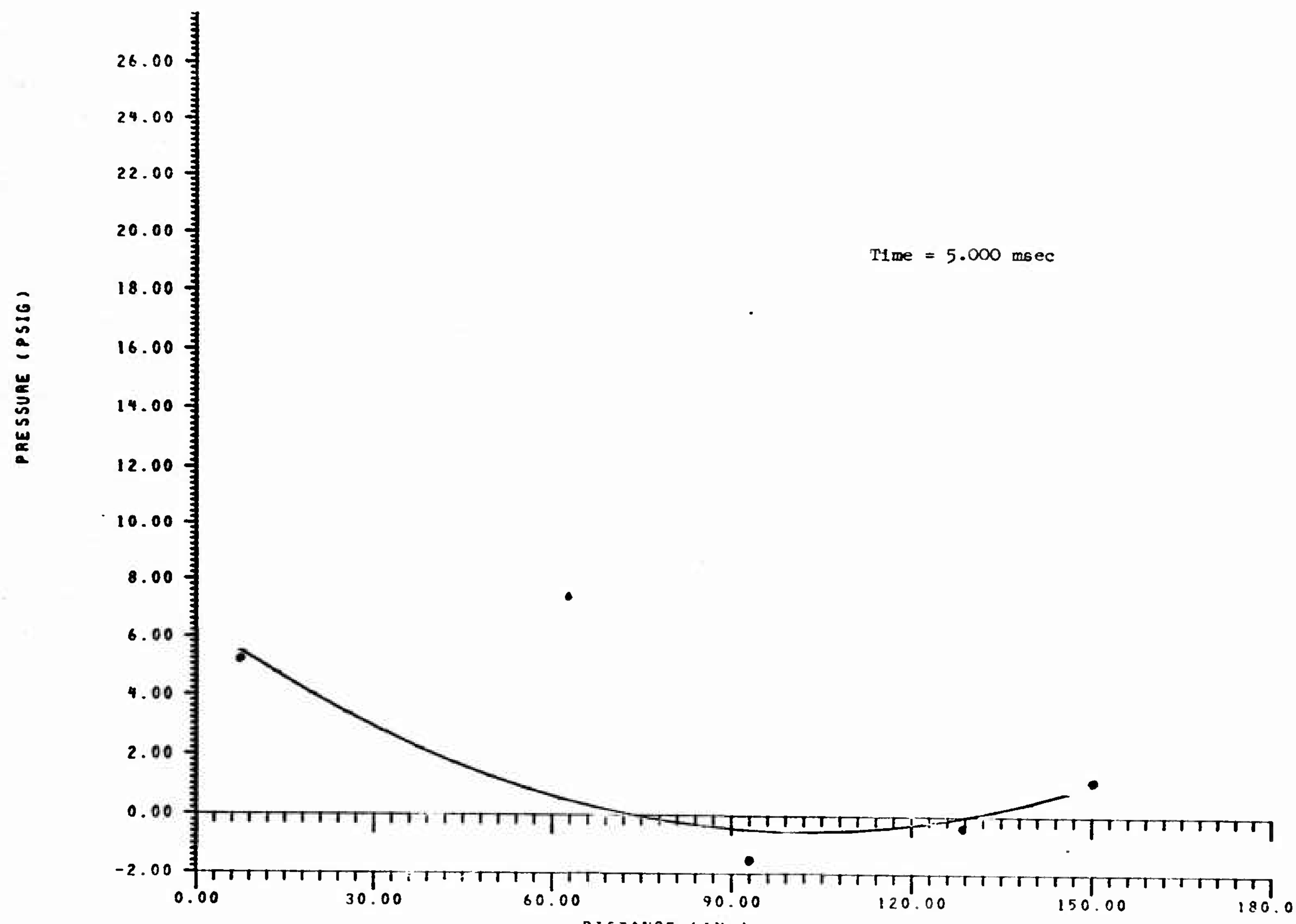
PRESSURE VS ANGLE AT STATION 3 - TEST 116



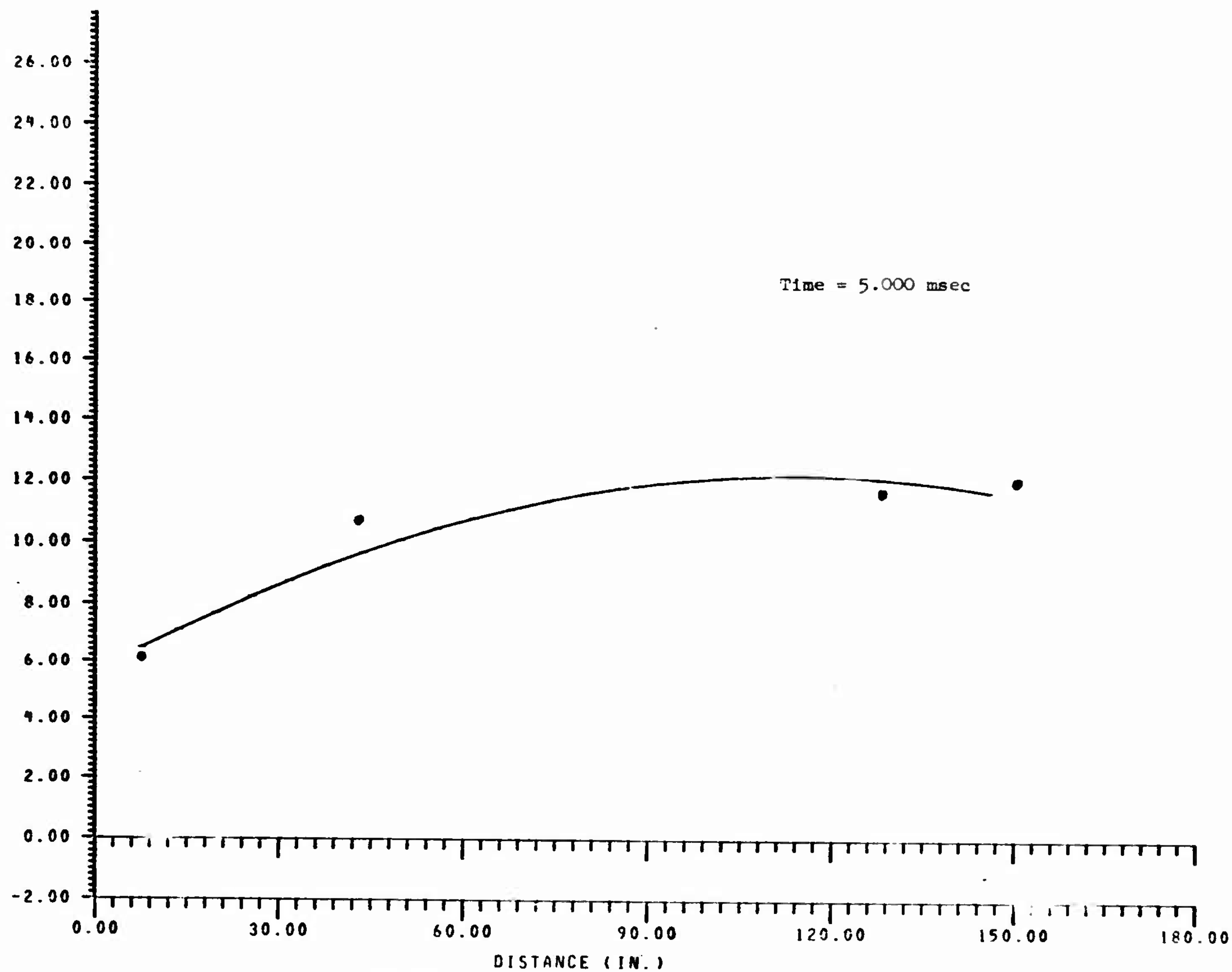
PRESSURE VS ANGLE AT STATION 4 - TEST 116



PRESSURE VS DISTANCE AT 0° - TEST 116



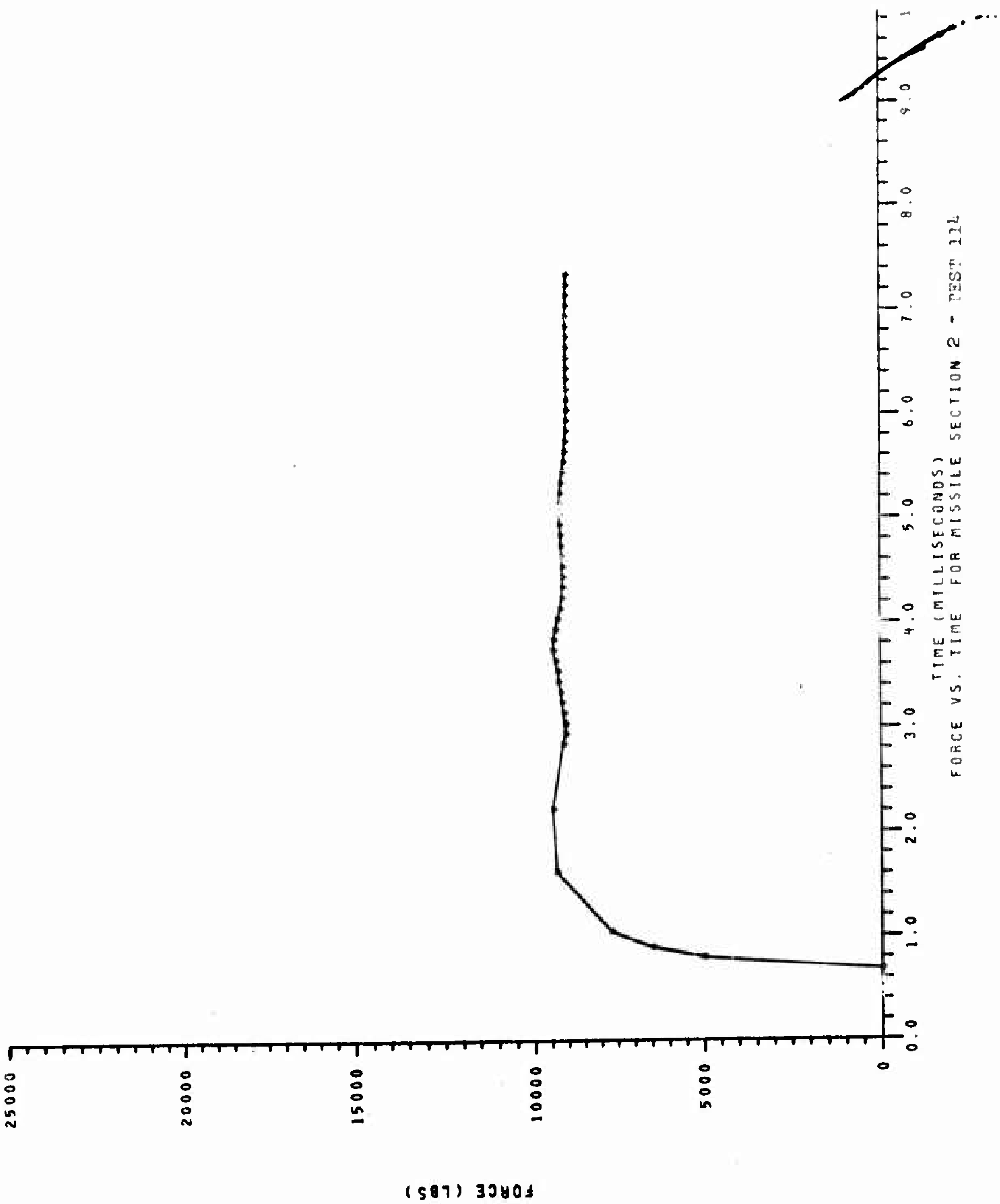
PRESSURE VS DISTANCE AT 90° - TEST 116



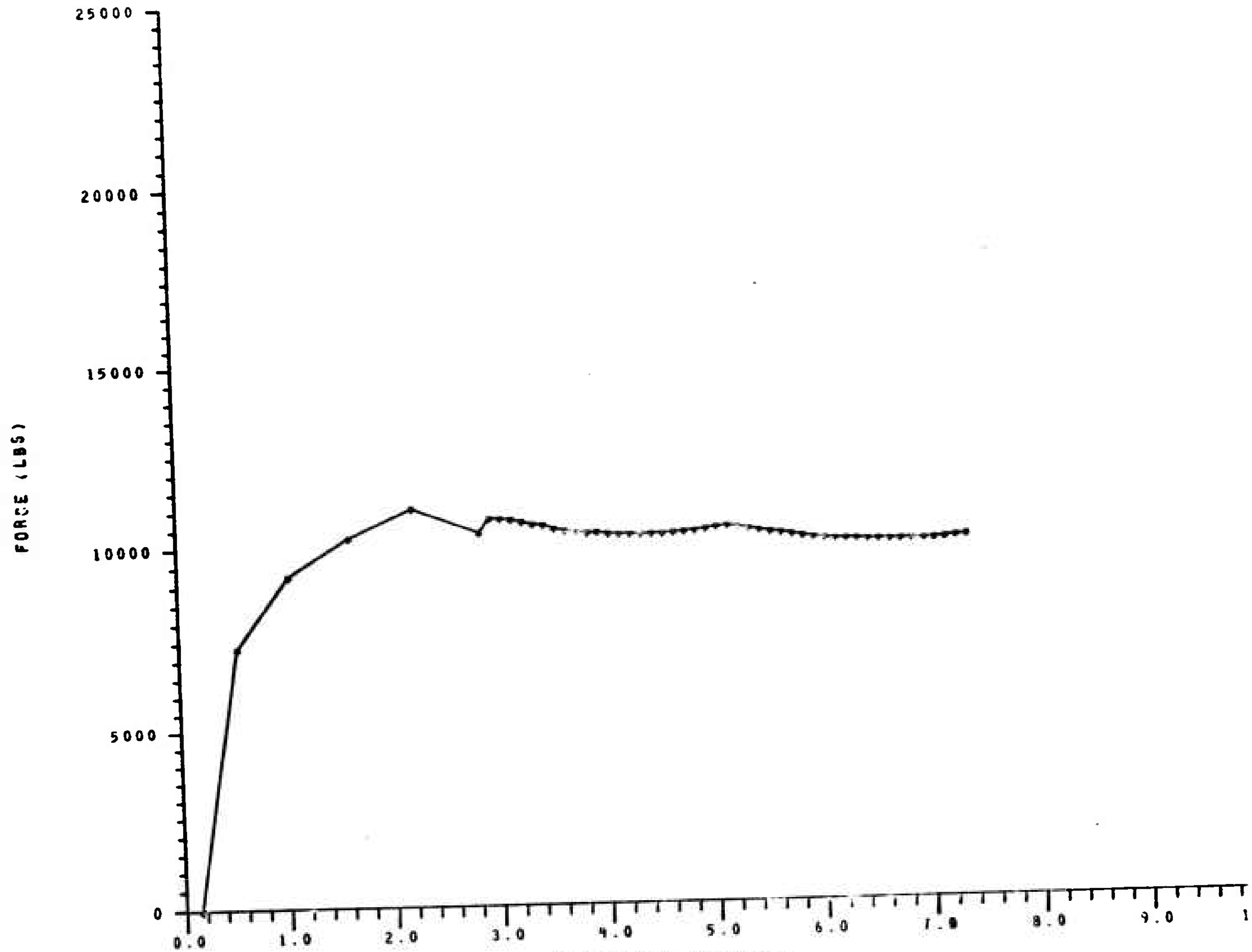
PRESSURE VS DISTANCE AT 180° - TEST 116

APPENDIX E

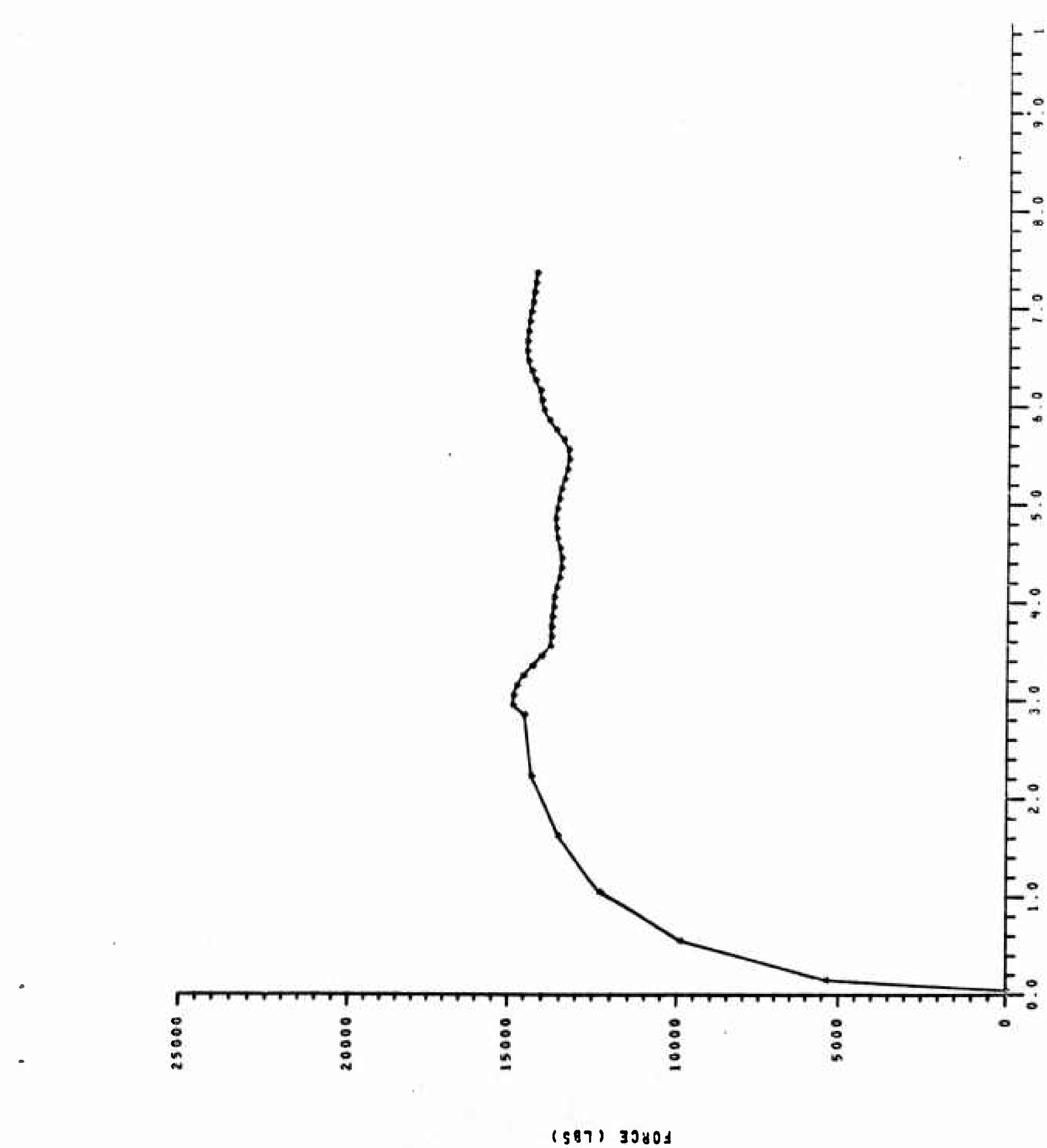
FORCE-TIME HISTORIES



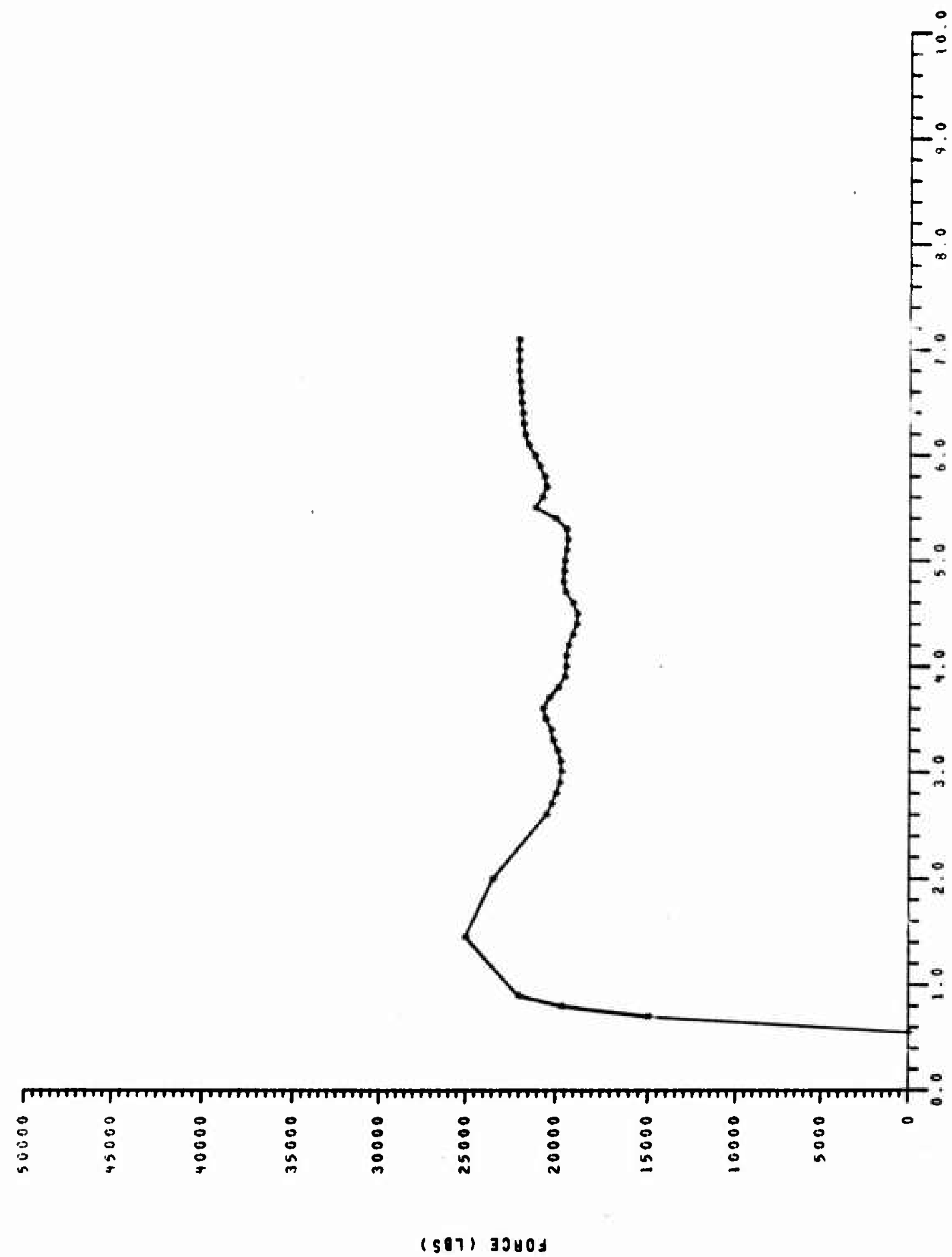
FORCE VS. TIME FOR MISSILE SECTION 2 - TEST 114



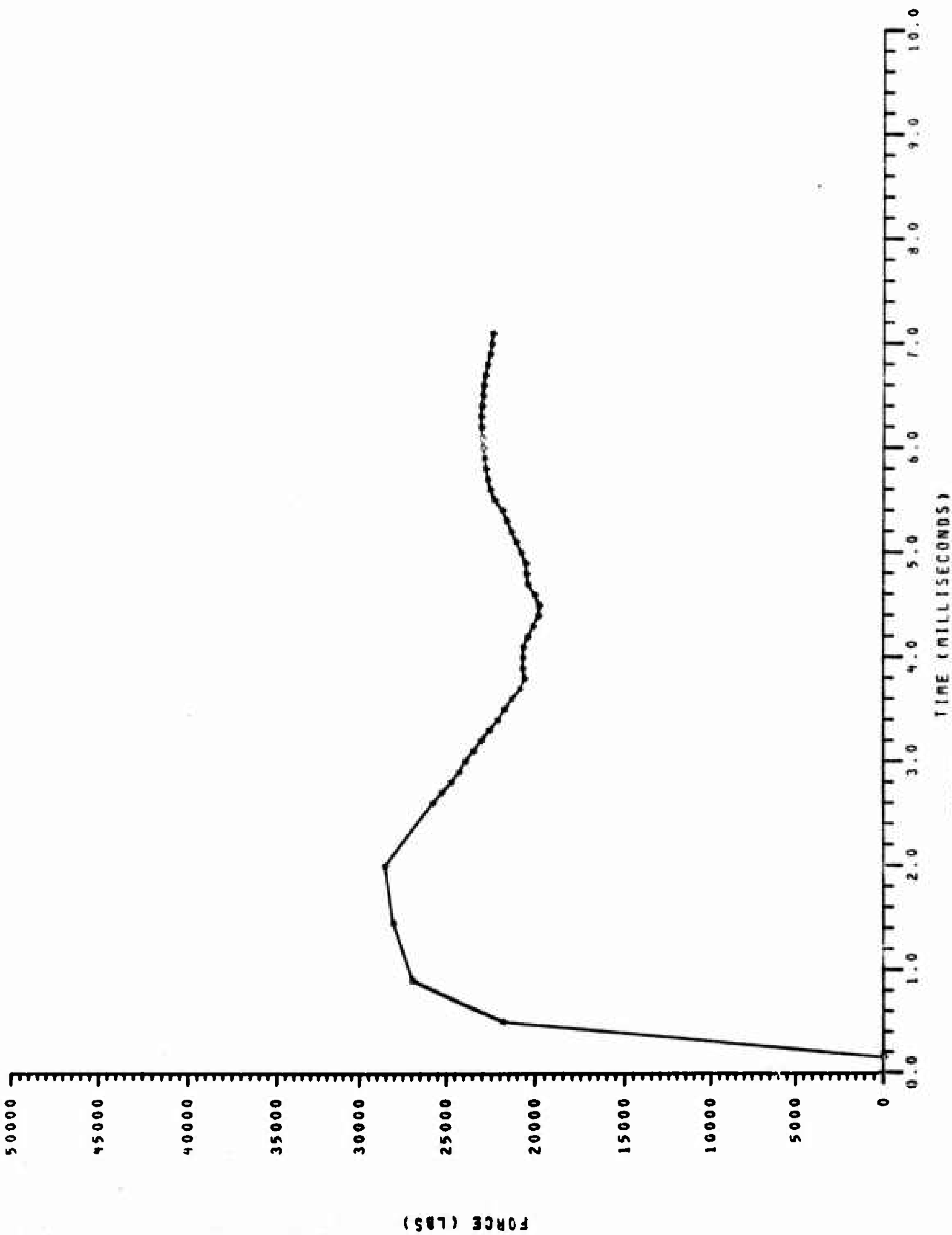
FORCE VS. TIME FOR MISSILE SECTION 3 - TEST 114



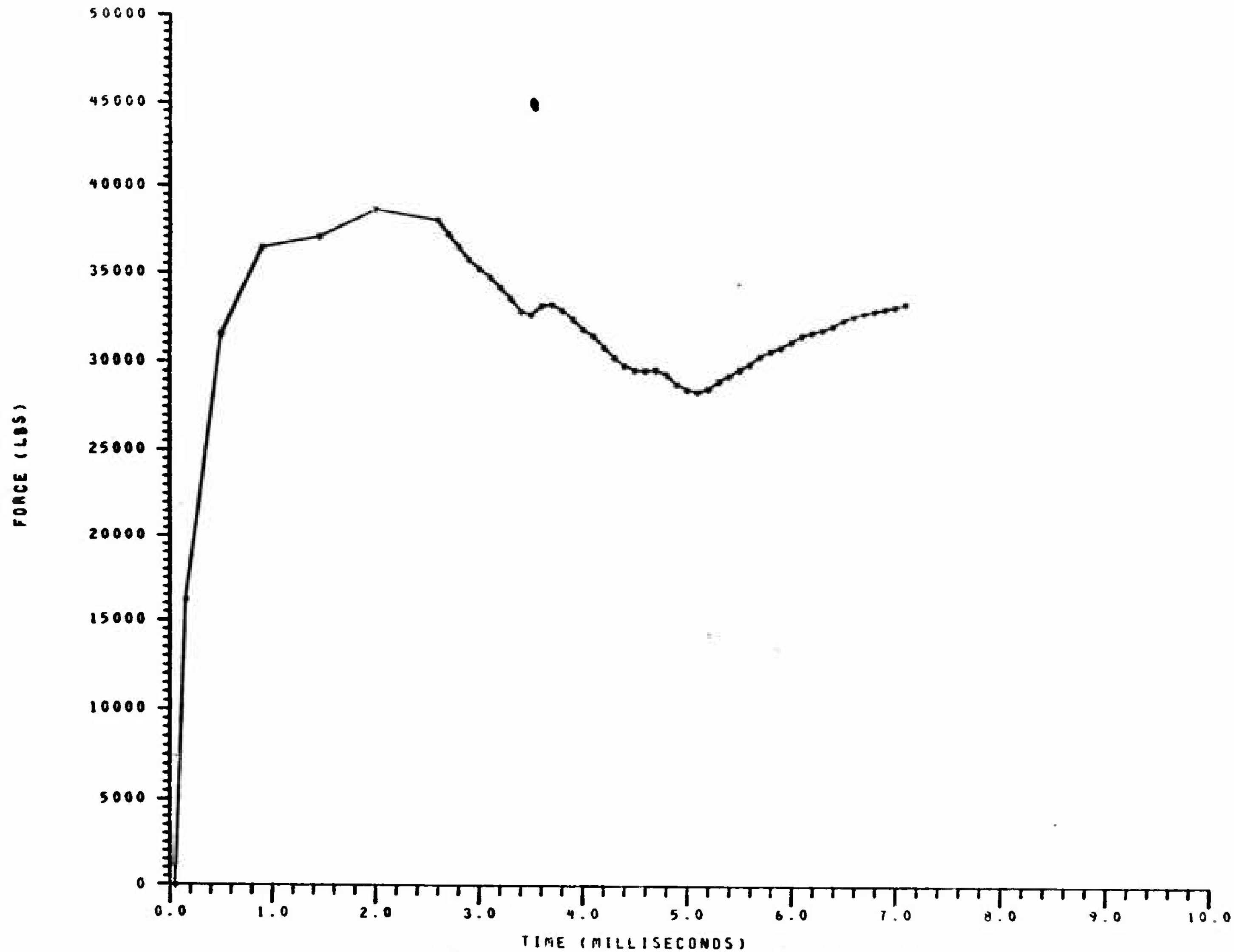
FORCE VS. TIME FOR MISSILE SECTION 4 - TEST 114



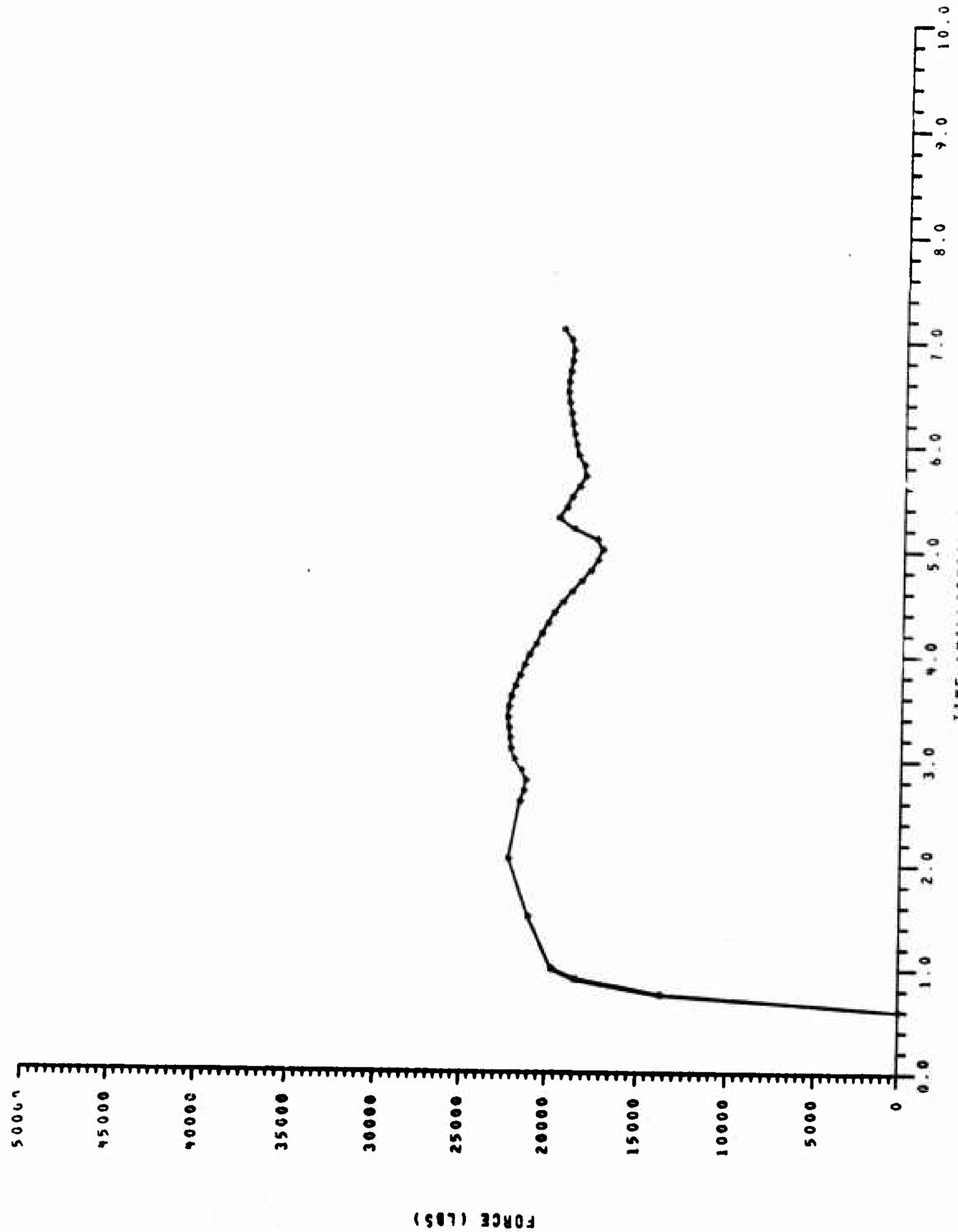
FORCE VS. TIME FOR MISSILE SECTION 2 - TEST 115



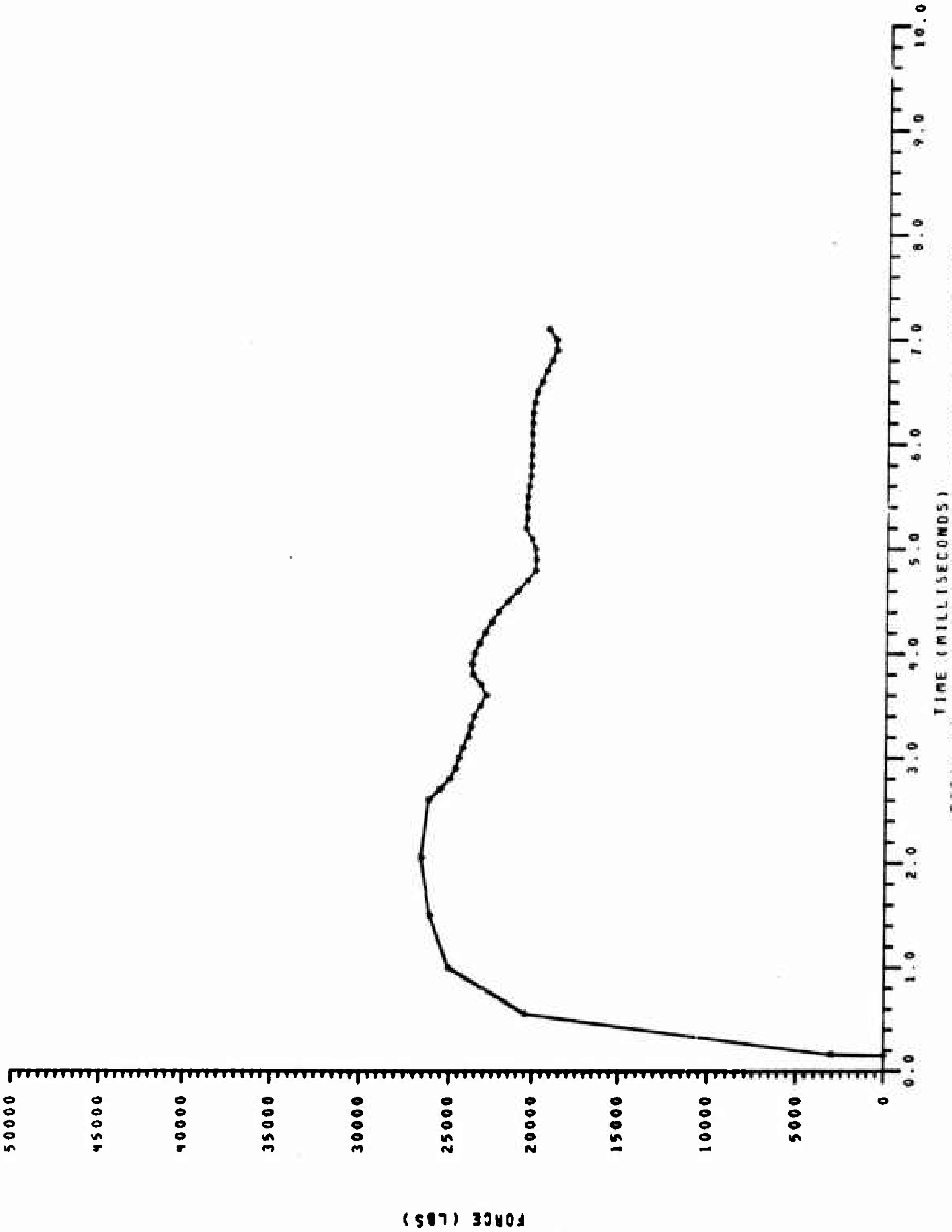
FORCE VS. TIME FOR MISSILE SECTION 3 - TEST 115



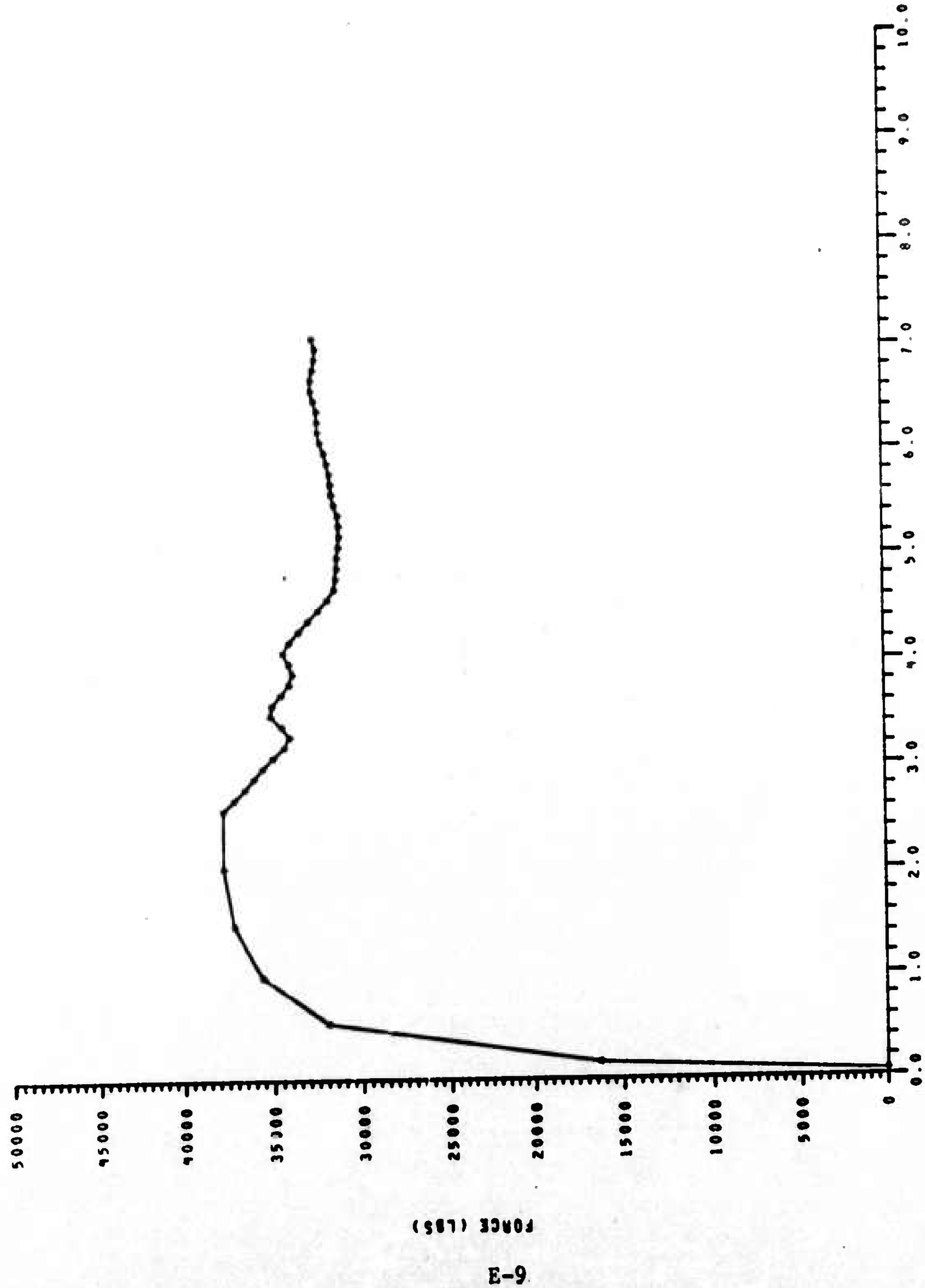
FORCE VS. TIME FOR MISSILE SECTION 4 - TEST 115



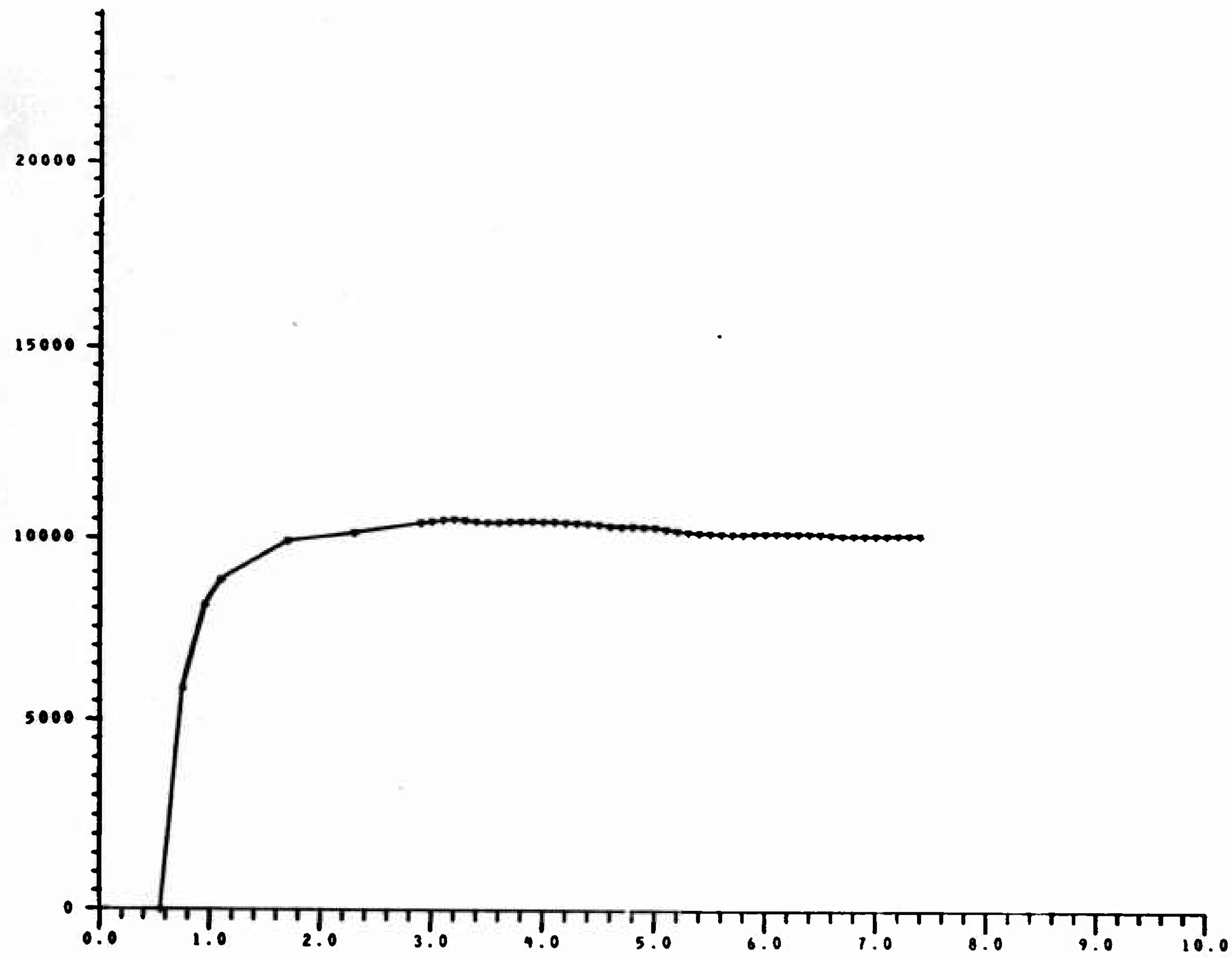
FORCE VS. TIME FOR MISSILE SECTION 2 - TEST 116



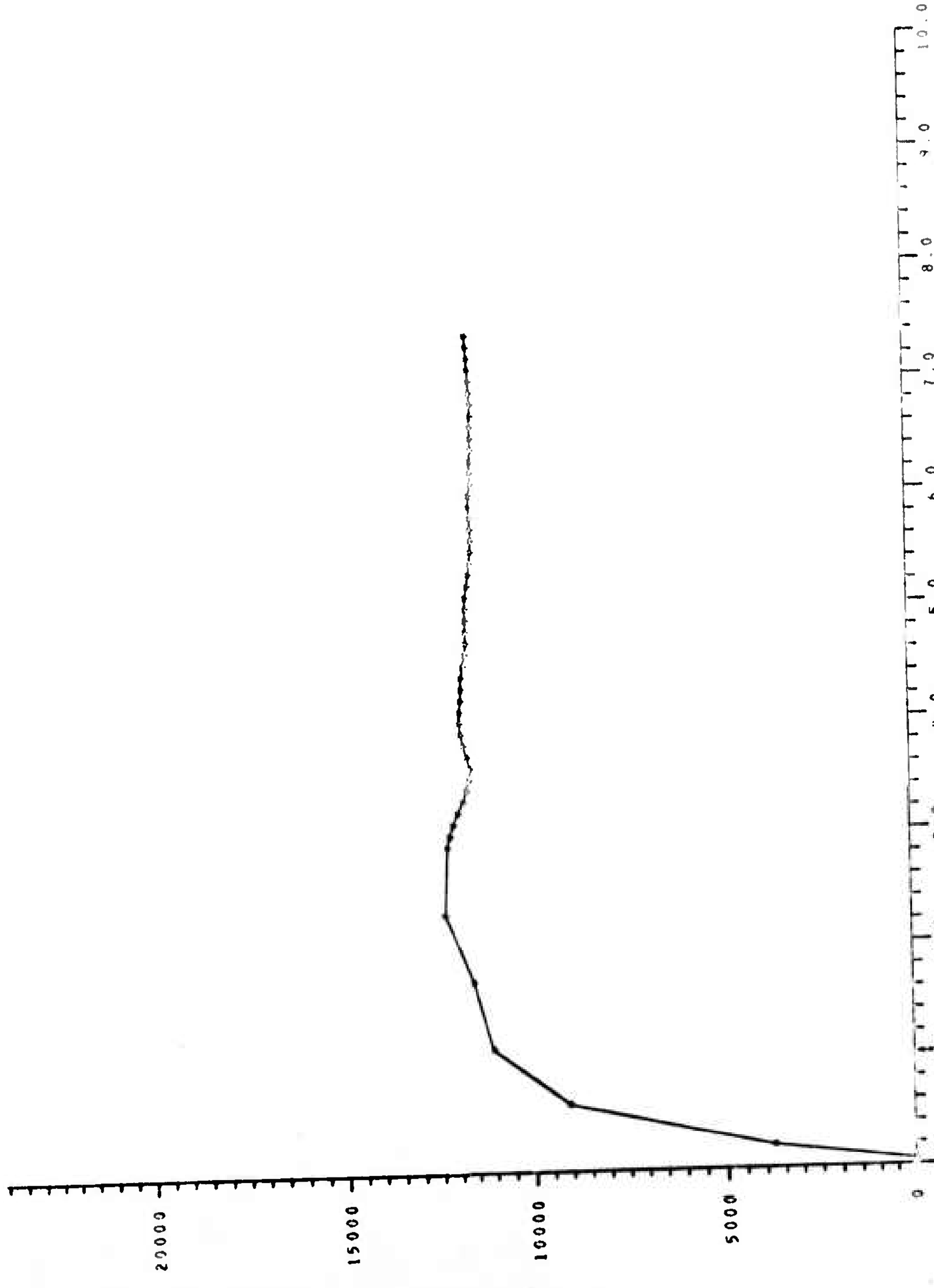
FORCE VS. TIME FOR MISSILE SECTION 3 - TEST 116



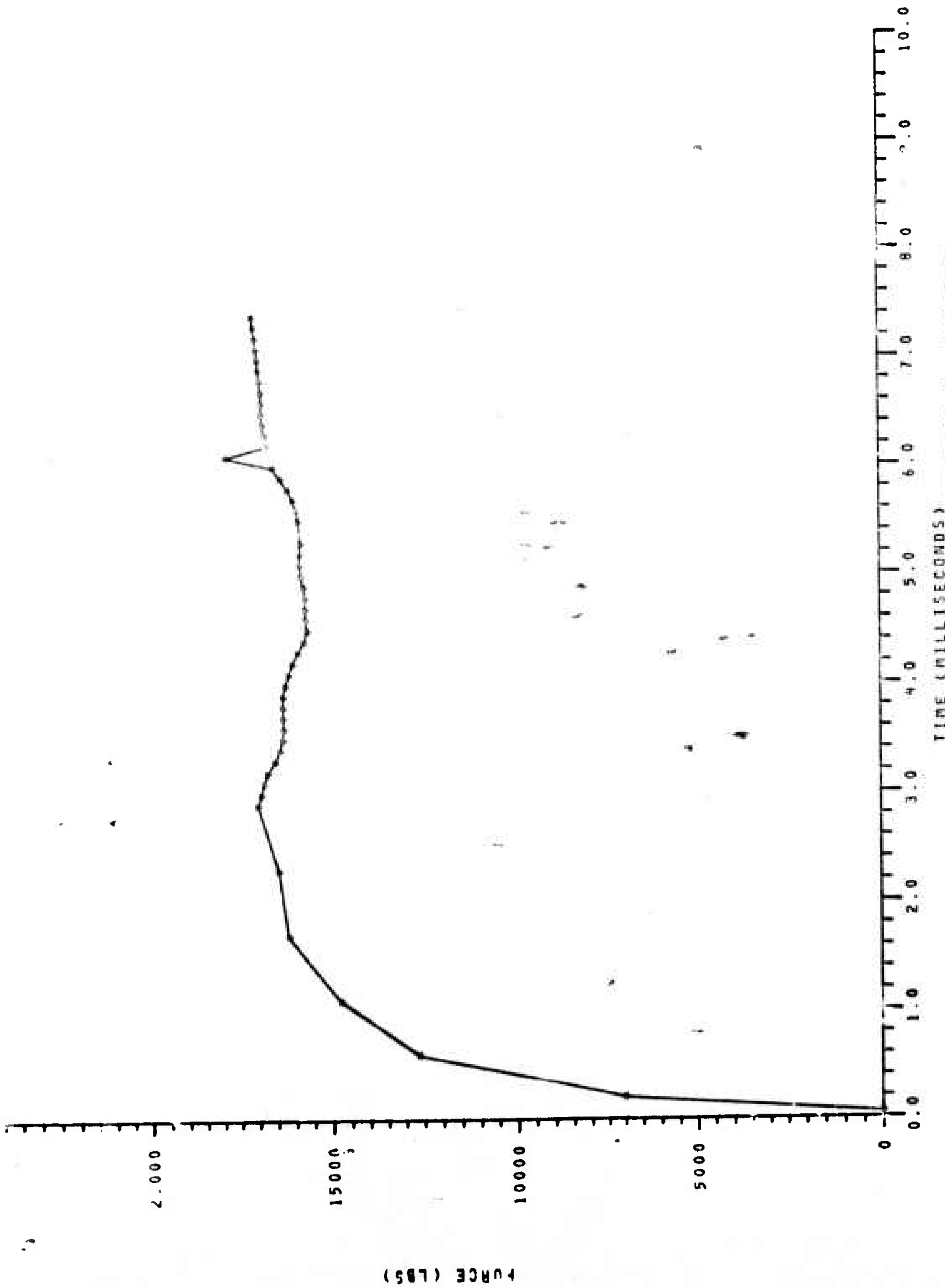
FORCE VS. TIME FOR MISSILE SECTION 4 - TEST 116



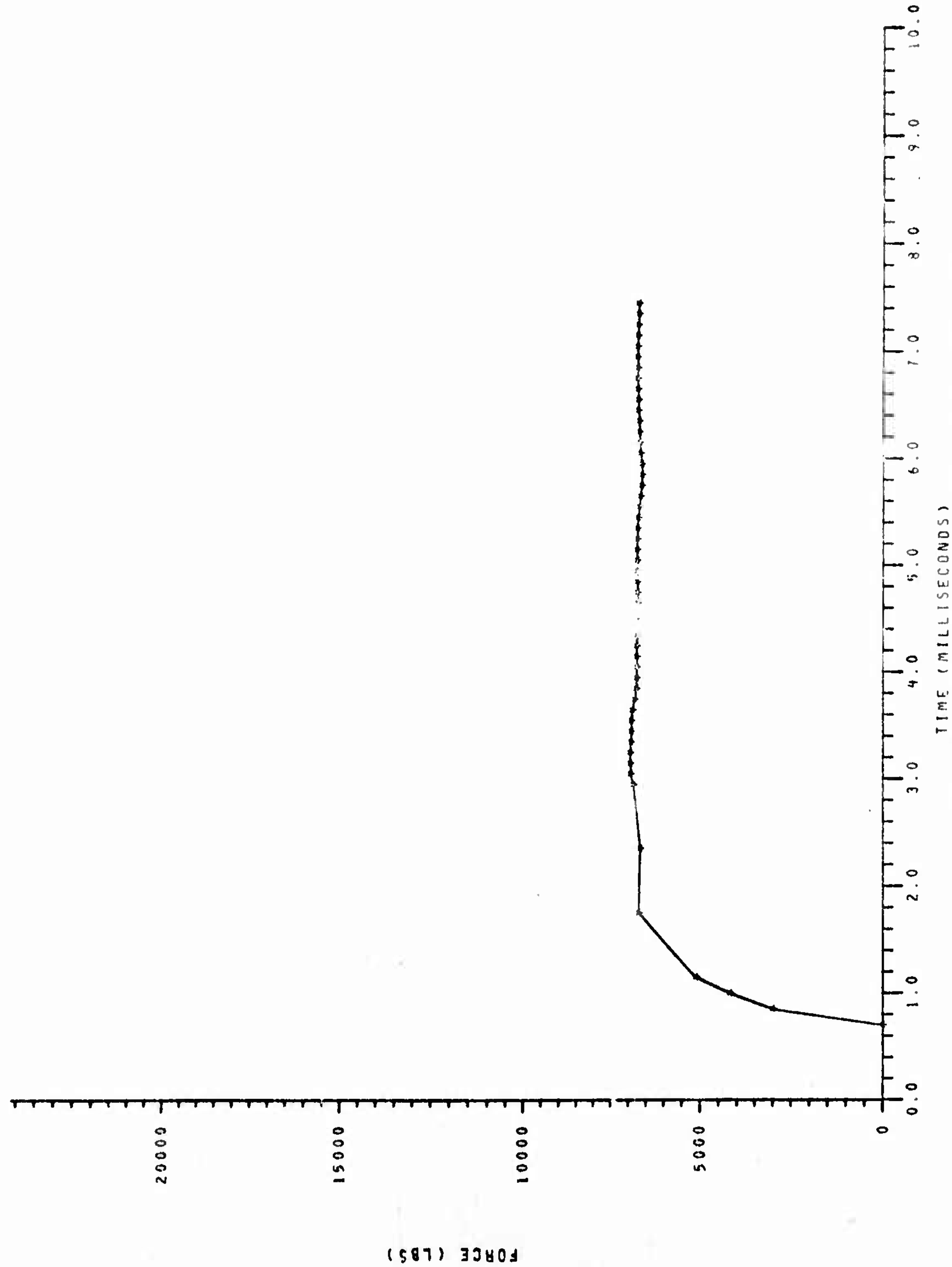
FORCE VS. TIME FOR MISSILE SECTION 2 - TEST 117



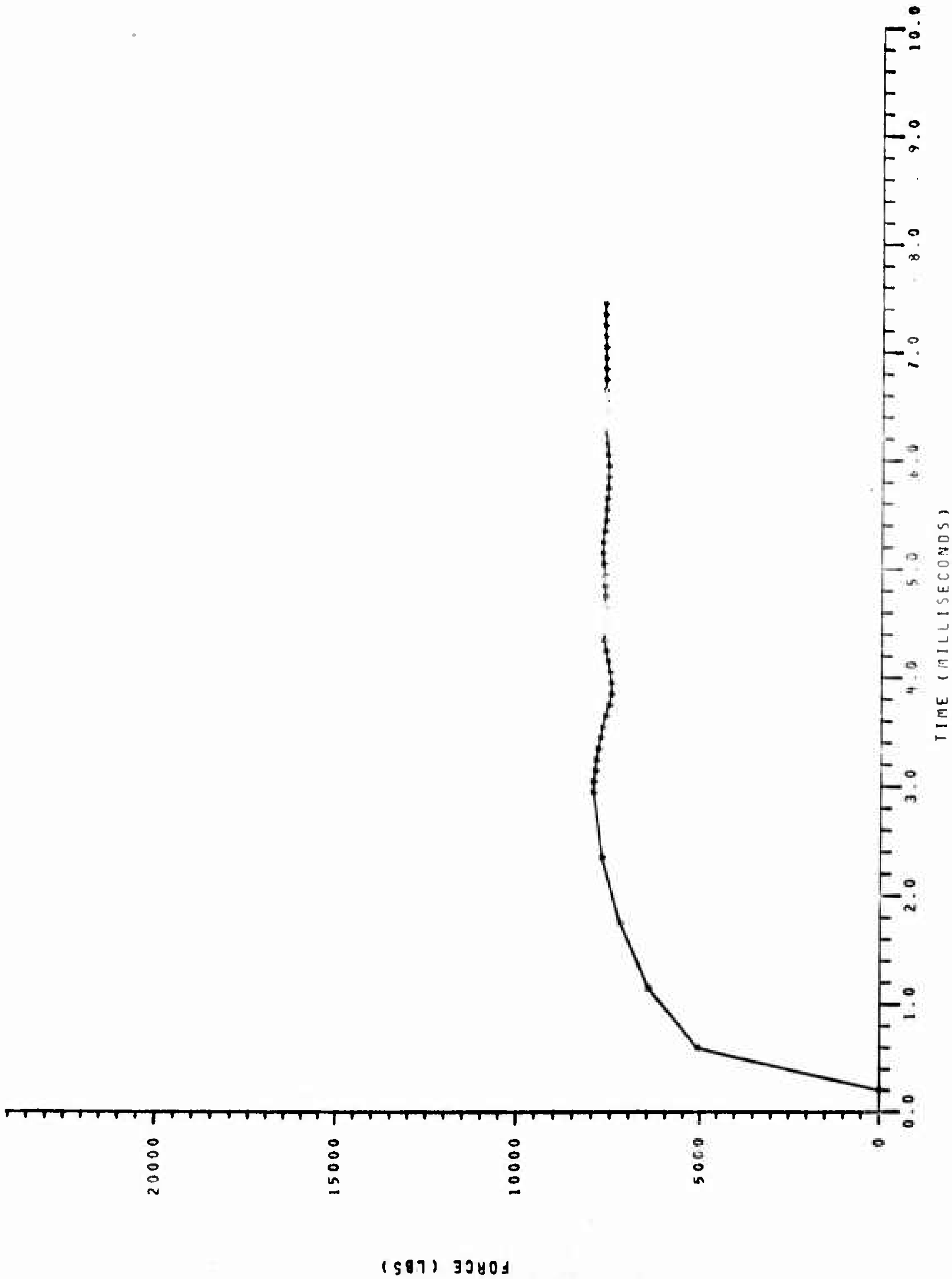
FORCE VS. TIME FOR MISSILE SECTION 3 - TEST 11



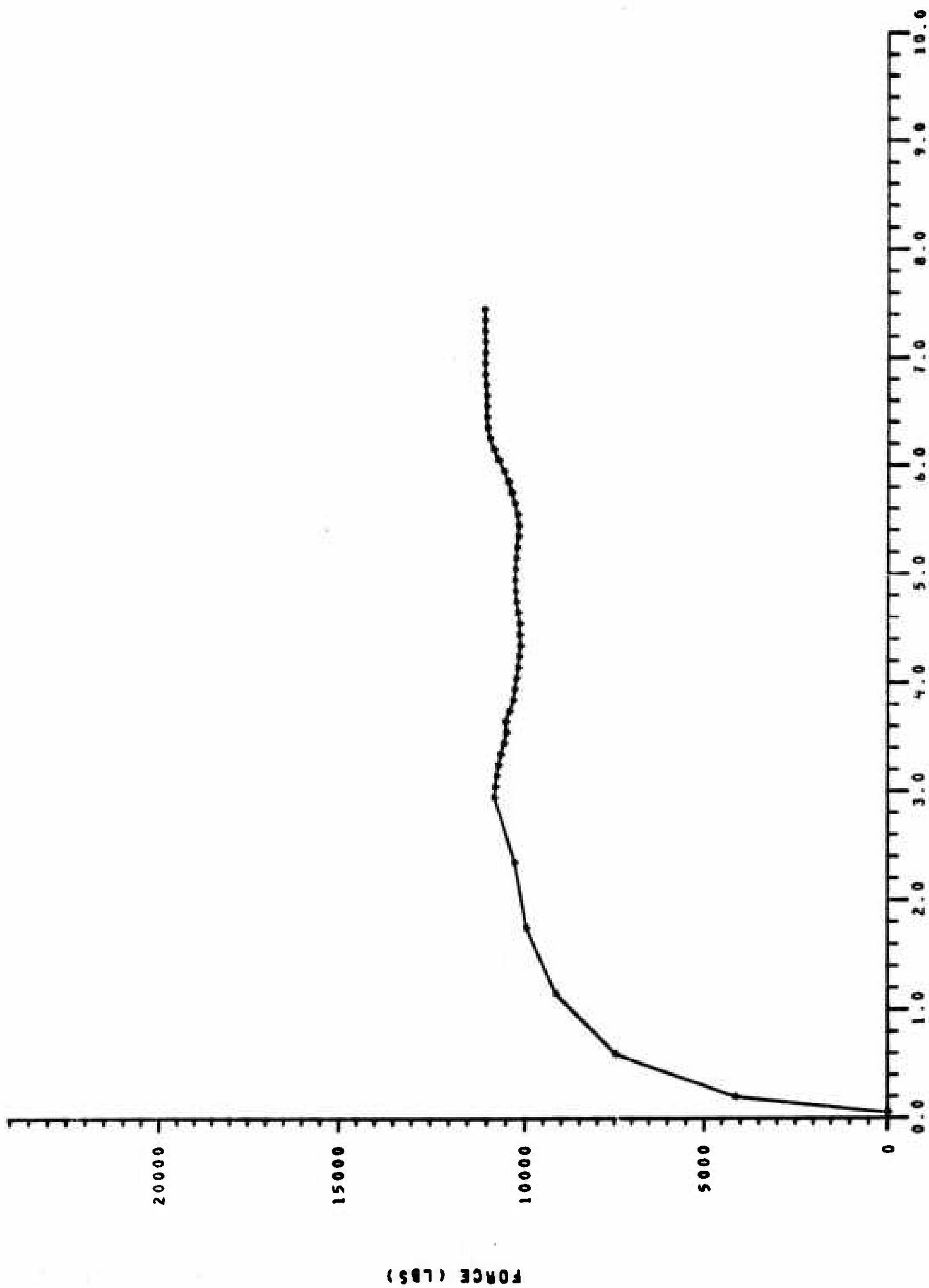
FORCE VS. TIME FOR MISSILE SECTION 4 - TEST 117



FORCE VS. TIME FOR MISSILE SECTION 2 - TEST 113



FORCE VS. TIME FOR MISSILE SECTION 3 - TEST 113



FORCE VS. TIME FOR MISSILE SECTION 4 - TEST 118

APPENDIX F

DISTRIBUTION

DISTRIBUTION

Commanding Officer
Naval Ship Systems Command Headquarters
Washington, D. C. 20360

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314 (2)

NASA
Scientific and Technical Information Facility
P. O. Box 33
College Park, Maryland 20740 (5)

Director of Defense Research and Engineering (OSD)
Washington, D. C. 20301
Attn: Technical Library

Director
Advanced Research Projects Agency
Department of Defense
Washington, D. C. 20301

Commander
U. S. Naval Ordnance Laboratory
White Oak, Silver Spring, Maryland 20910
Attn: Code 241 (3)

Director
Defense Nuclear Agency
Washington, D. C. 20301
Attn: Code SPSS (5)
DASIAC Project Officer (2)

Director
U. S. Army Ballistic Research Laboratories
Aberdeen Proving Ground
Aberdeen, Maryland 21005
Attn: Terminal Ballistics Laboratory (3)
Attn: Mr. J. J. Meszaros (2)

Commander
Naval Ships Engineering Center
Center Building, Prince George's Center
Hyattsville, Maryland 20782
Attn: Mr. Bob Fuss

DISTRIBUTION (Continued)

Director
U. S. Naval Research Laboratory
Washington, D. C. 20390

Commanding Officer and Director
U. S. Naval Civil Engineering Laboratory
Port Hueneme, California 93041

Commanding Officer and Director
Naval Ship Research and Development Center
Washington, D. C. 20007 (2)

Commander
Naval Fleet Missile Systems Analysis and Evaluation Group
Corona, California 91720
Attn: Library

AF Institute of Technology
AU Wright-Patterson Air Force Base
Dayton, Ohio 45433
Attn: Technical Library

Commanding Officer
Air Force Weapons Laboratory
Kirtland Air Force Base
Albuquerque, New Mexico 87117

Sandia Corporation
Sandia Base
Albuquerque, New Mexico 87115

Chief of Naval Material
Navy Department
Washington, D. C. 20360

Commanding General
U. S. Army Safegruard System Command
Attn: SSC-PMR
P. O. Box 1500
Huntsville, Alabama 23806 (2)

Martin Marietta Corporation
P. O. Box 5837
Orlando, Florida 32805

DISTRIBUTION (Continued)

McDonnell Douglas Astronautics Company/Western Division
Systems Center
5301 Bolsa Avenue
Huntington Beach, California 92647 (2)
Attn: Mr. S. I. Ogawa
Mr. Carroll Ailman

Kaman Avidyne
Division of Kaman Aircraft Corporation
Burlington, Massachusetts 01803
Attn: Mr. Garabed Zartarian
Mr. John Calligeros
Mr. Lawrence J. Mente

Local:
C
D
D-1
E
F
G
K
T
TM
TT
TP
TO
TF (10)
TI
TIR (10)
MIL (2)
MIP (5)
MIM

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

AN ANALYSIS OF AIR BLAST PRESSURE DATA ON THE SURFACE OF A SPARTAN MISSILE ASSEMBLY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (First name, middle initial, last name)

L. P. Anderson, Jr.

6. REPORT DATE
April 1973

7a. TOTAL NO. OF PAGES

7b. NO. OF REFS

8a. CONTRACT OR GRANT NO.

b. PROJECT NO.

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

NWL TR-2895

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT

Distribution limited to U.S. Gov't. agencies only; Test and Evaluation; April 1973. Other requests for this document must be referred to the Commander, Naval Weapons Laboratory, Dahlgren, Virginia 22448.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

13. ABSTRACT

This report describes an unsteady pressure distribution due to a blast wave diffracting around a SPARTAN missile assembly. The pressure data were obtained from a series of five tests performed in the DASACON Conical Shock Tube Facility located at the Naval Weapons Laboratory, Dahlgren, Virginia. These tests were conducted during the period 17 April 1972 to 8 May 1972. During these tests the missile assembly was subjected to incident blast waves which had peak overpressures of from 2.9 psi to 11.8 psi and corresponding positive overpressure durations of from 380 milliseconds to 444 miliseconds.

The report describes the pressure data for each test the empirical function used to represent these data. It then describes the method of integrating the empirical function at given times for the missile assembly sections of interest. The results of these calculations for all five tests are given at selected times. The calculation period covers approximately seven milliseconds beginning at the time the blast wave first encounters the missile assembly. These results are given as force vs time plots in Appendix D.